Research Migration Project

https://esim.fossee.in/research-migration-project

The Research Migration Project is an initiative of FOSSEE, IIT Bombay that promotes the use of eSim for reproducing published research circuits originally implemented using proprietary simulation tools. The objective is to migrate these validated designs to eSim to build an open source resource database.

Name of the participant : *(Enter the full name as it should appear in certificates and official records.)

Dr Ashutosh Sudhirrao Werulkar

Affiliation / Institution : *(Mention department, institution/organization name, city, state, and country. Example: Department of Electrical Engineering, IIT Bombay, Mumbai, Maharashtra, India.)

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Pin Code:-441108

Title of the circuit : *(Provide a clear and descriptive title of the circuit. The title should reflect the main functionality or application of the circuit.)

Esim Simulation of High Efficiency Zero Voltage Switching(ZVS) and zero current switching(ZCS) DC- DC Boost converter for Solar PV Systems applications

Theory/Description : *(Briefly explain the theoretical background of the circuit. Describe the principle of operation, key components used, and how the circuit functions overall. Keep it concise and technically accurate.)

Soft switching DC-DC converters play an important role in deciding the efficiency of the solar PV system. In order to improve the efficiency of energy conversion for a photovoltaic (PV) system, a soft-switching boost converter is used. The energy efficiency increases due to reduced switching losses in soft switching converters. The circuit of ZVS boost converter has been analysed. This circuit uses a main switch using a simple auxiliary resonant circuit, composed of an auxiliary switch, a diode, a resonant inductor, and a resonant capacitor. The conventional boost converter decreases the efficiency because of hard switching, which generates losses when switches are turned on/off. All switches in the adopted circuit perform zero-current switching by the resonant inductor at turn-on and zero-voltage switching by the resonant capacitor at turn-off. This switching pattern reduces the switching losses, voltage and current stresses of both switching devices. Switches S1 and S2 are NPN power transistors, capacitors C1 and C2 are electrolytic capacitors and capacitor Cr is an AC capacitor. The auxiliary circuit consists of an auxiliary switch (*S*2), a resonant capacitor (*Cr*), a resonant inductor (*Lr*), and two diodes (*D*1 and *D*2). For simulation purpose, instead of MOSFETS, NPN transistors are used.

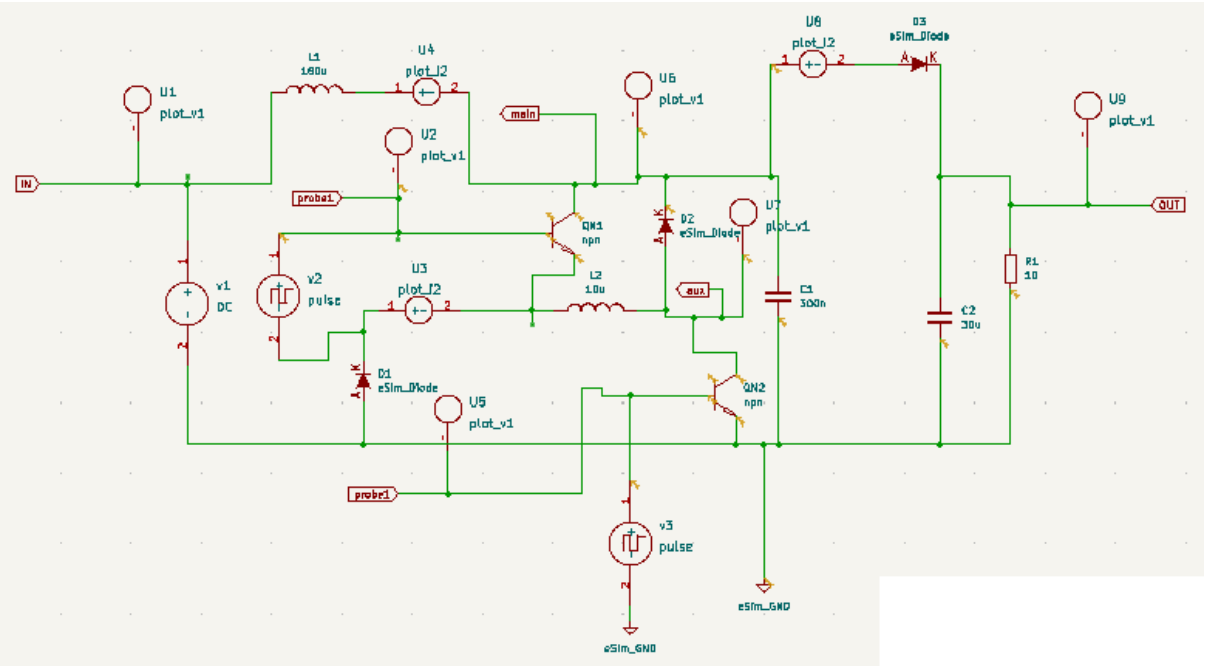
Reason to reproduce with eSim : (Explain why this circuit is suitable for simulation and reproduction using eSim. Mention benefits such as open-source availability, educational value, ease of simulation, verification of results, or improvement over existing designs.)

This circuits is suitable for simulation on E-sim environment as this software is open source and user friendly free software which can be easily used by everyone. eSim version 2.5 is used for simulation purpose.Open source softwares are highly beneficial for technical community and professionals as these are freewares .

Expected Outcome/outputs : *(Describe what is expected when the circuit is simulated or implemented. Explain the working behavior, measurable outputs, and how the circuit performance can be validated.)

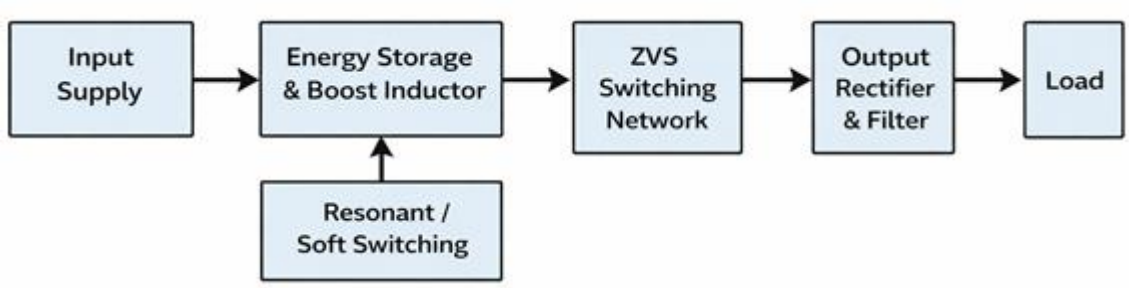
The circuit simulates especially ZVS and ZCS condition along with voltage and current waveforms of the switches. When the circuit is simulated, different nodes and probes are connected to generate waveforms for main switch current, voltage, auxiliary switch voltage, output diode current, input voltage and output voltage, pulse voltage waveforms. Output voltage is the boosted voltage which is more than input voltage. But it is having ripple. This ripple voltage can be reduced by increasing the value of output capacitor. Three sample waveforms of input and output voltages have been included.

Circuit Diagram(s) : *(Provide a detailed schematic of the circuit showing all components, connections, values, and labels. A circuit diagram is required to understand and evaluate the proposed work.)



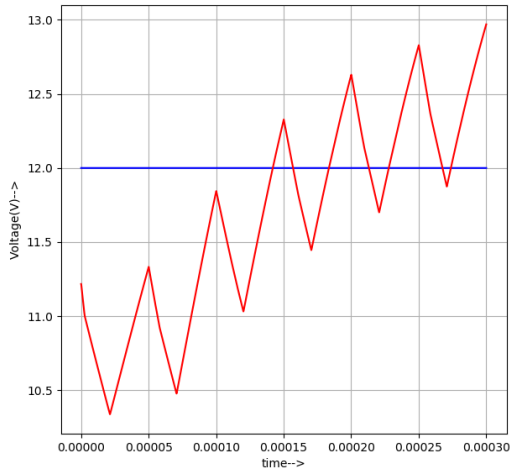
Block Diagram (s) : (Include a high-level block diagram showing major functional blocks and signal flow. This helps in understanding the system architecture before detailed

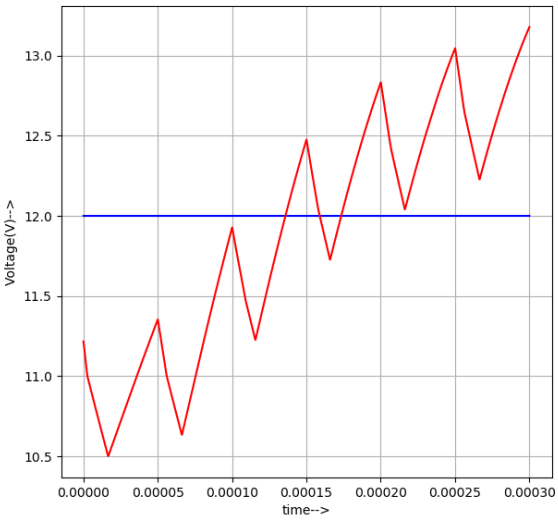
implementation.)

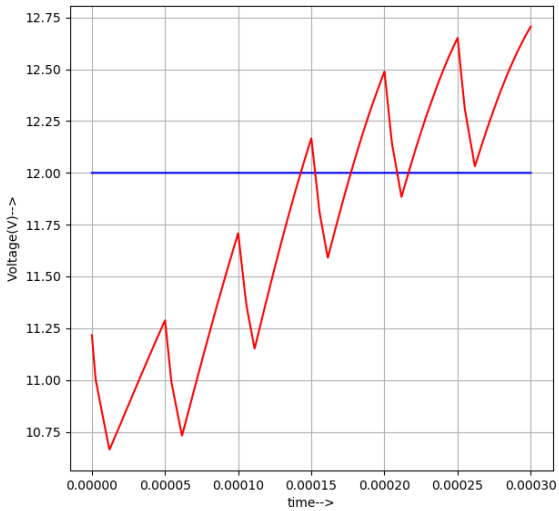


Expected Results (Input, Output waveforms and/or Multimeter readings) : ***(Mention the expected input and output signals, waveform shapes, voltage/current levels, frequency values, or multimeter readings obtained from simulation or analysis.)**

Input and output waveforms at different duty cycles







Research Paper/Journal/etc. : ***(Providing at least one relevant research paper, journal article, or patent reference is mandatory. The reference should be directly related to the**

proposed circuit. Proposals submitted without a valid reference will not be accepted.)

Title : **(Title of the paper/patent)**

Design and Application For PV Generation System Using A Soft-Switching Boost Converter With SARC

Author : **(Author names as per publication)**

Sang-Hoon Park, Gil-Ro Cha, Yong-Chae Jung, and Chung-Yuen Won

Page No. : pp 515-522

(Page numbers, if available)

Link : **(Direct link to IEEE / Scopus / Google Scholar / Patent source)**

https://ieeexplore.ieee.org/document/5332307

Source/Reference(s) : **(Mention textbooks, websites, application notes, datasheets, or any other resources used while designing or understanding the circuit.)**

Marian K.Kazimier,"Pulse Width modulated DC-DC power converters" John Wiley and Sons Limited, 2008

Note: Fields marked with an asterisk (*) are mandatory and must be filled for successful submission.