

A Single Switch Similar Resonant Power Converter for Electrical Phenomenon Generation Application**K.Shilpa**²Asst proff, Dept of EEE, SVS Institute of Technology, Hanamkonda, T.S INDIA.**D.Kumara Swamy**³Assoc proff, H.O.D, Dept of EEE, SVS Institute of Ttechnology, Hanamkonda, T.S INDIA**V. Divyasri , E.Shylaja , J.Sagar , V.Srinivas**¹B Tech scholars, Dept of EEE, SVS Institute of Technology, Hanamkonda, T.S INDIA.**Abstract**

This paper develops one switch similar resonant power converter for electrical phenomenon generation application. This circuit topology integrates a single-switch similar resonant electrical converter with zero voltage change (ZVS) with energy interference diode with zero current change (ZCS).

The energy interference diode with an instantaneous current output filter filters the output stage of the single-switch similar resonant electrical converter. Only 1 active power switch is employed for power energy conversion to scale back the value of active power switches and management circuits. The active power switch is controlled by pulse breadth modulation (PWM) at a set change frequency and a continuing duty cycle. Once the resonant convertor is operated at discontinuous physical phenomenon mode, the electrical device current through the resonant tank might deliver the goods ZCS of energy interference diode. Consequently, high energy conversion potency is ensured.

Operational principles square measure derived, and analysis is distributed supported equivalent circuits for the projected power convertor below totally different operational modes. The operational principles of the convertor were verified employing a thirty two.4- W, 70-KHz experimental photovoltaic-powered load system. Given close to chosen circuit parameters, the active power switch is operated with ZVS, and a measured energy conversion potency of the projected topology of ninety seven.3% is achieved.

Experimental results demonstrate a satisfactory performance of the projected topology that is especially suited to the energy conversion applications in renewable energy generation applications.

Keywords: ZCS, ZVS, Energy, PWM, Circuits, Topology.

Introduction

NOW-A-DAYS, most power used that is used to meet our daily needs is obtained from fossil fuels. Owing to increases in consumption, fossil fuel sources may be exhausted in the near future. The Kyoto agreement on the global reduction of greenhouse gas emissions that are produced by the burning of fossil fuels seeks a reduction in the use energy from such sources. However, Taiwan is a highly energy-dependent nation, which meets approximately 97% of its energy needs by importing fuels. Environmental pollution and greenhouse gas emissions are becoming significant environmental issues in the country. Therefore, renewable energy has become attractive in recent years, following the implementation of a policy for sustainable development and mitigation of environmental pollution in Taiwan. Accordingly, means of generating renewable energy are being developed. They include wind turbines, photovoltaic (PV) modules, and fuel cell systems .

PV power generation systems have been regarded as the most promising future sources of energy because of their advantages, such as the absence of a need for fuel and the associated cost saving, low maintenance, and lack of noise. Fortunately, Taiwan is located in a subtropical zone that is close to the equator, and southern Taiwan, in particular, experiences strong sunshine in the summer.

Consequently, the energy collected on PV arrays is utilized as the source of a renewable energy for reduction of fossil fuel energy. If the direct-current (dc) output of renewable energy generation systems is directly connected to a battery energy storage system (BESS), then the output voltage of the dc output source of the renewable energy generation system will be fixed to the voltage of the BESS, so the renewable energy generation system cannot always operate optimally. Hence, a dc/dc interface must be installed between the renewable energy generation system and the BESS to ensure that the renewable energy generation system always operates at its optimum operating points.

Power electronics use switching circuits to transform energy and control power flow. Power semiconductor switches critical components of power electronic circuits. The simplest method for controlling power semiconductor switches is pulse width modulation (PWM). The PWM approach is to control power flow by interrupting current or voltage by switching with control of the duty cycles. Conventionally, the voltage across or current through the semiconductor switch is abruptly altered; this approach is called hard-switching PWM. Because of its simplicity, relatively low current stress, and ease of control, hard-switching PWM approaches have been preferred in modern power electronics converters. Owing to the rapid developments of new power device technologies, the switching speed of power devices has increased greatly. Therefore, PWM power converters can now operate at a much higher switching frequency, reducing the size of passive components, reducing the overall cost of the system. However, the converter switching loss also increases in proportion to the frequency. The increases in dv/dt and di/dt caused by the increased speed increase stress on the device and system electromagnetic interference noise. These effects set an upper limit on the frequencies at which conventional hard-switching PWM converters can operate. In the last few decades, various research studies have been performed to improve the switch transition to overcome this inherent problem of hard-switching PWM converters. By solving these high voltage and current stress problems, energy conversions using resonant converters have been important in ensuring both high performance and supporting energy conservation applications in renewable energy generation systems.

Resonant converters are extensively utilized in the application of renewable energy generation systems. The basic requirements of resonant converters are their small size and high efficiency. A high switching frequency is required to achieve small size. However, the switching loss increases with the switching frequency, reducing the efficiency of the resonant converters. To solve this problem, some soft-switching approaches must be used at high switching frequencies. Zero voltage switching (ZVS) and zero-current switching (ZCS) techniques are two commonly used soft-switching methods. In these techniques, either voltage or current is zero during the switching transition, substantially reducing the switching loss and increasing the reliability of resonant converters in renewable energy generation systems. Traditional ZCS converters operate with constant on-time control. They must operate with a wide range of switching frequencies when the ranges of the input source and load are wide, making the filter circuit design difficult to optimize. However, the traditional ZVS scheme eliminates capacitive turn-on losses and decreases the turnoff switching losses by reducing the rate of increase in voltage, reducing the overlap between the switch voltage and the switch current.

This work develops a novel single-switch highly efficient converter with ZVS topology based on the traditional ZVS concept for renewable energy generation applications.

It's important features include a simple circuit structure, ease of control, soft switching for active power devices, low switching losses, and high energy conversion efficiency. This novel single-switch high-efficiency converter with ZVS topology can be considered to be an extension of the traditional ZVS power converter. It utilizes a capacitor across the active power switch in the novel single-switch power converter to generate a freewheeling state with a traditional ZVS power converter, enabling the novel converter to operate with a constant frequency and a markedly much reduced circulating energy.

This paper proposes a novel single-switch resonant power converter that has only a single ended structure and is therefore unlike the traditional ZVS converter, which must have an isolated circuit to trigger the active power switch. The use of a novel single-switch resonant power converter in the dc/dc energy conversion stage in a renewable energy generation system provides many advantages, such as a low number of components, low cost, and high power density. These characteristics, as well as the fact that the novel ZVS resonant power converter has only a single active power switch, cause the novel power converter to have a very simple structure, low switching losses, a small volume, and a low weight. In addition, since the commutations in the active power switch of the resonant power converter are performed at zero voltage, the switching losses are very low, resulting in very high efficiency.

Circuit Description

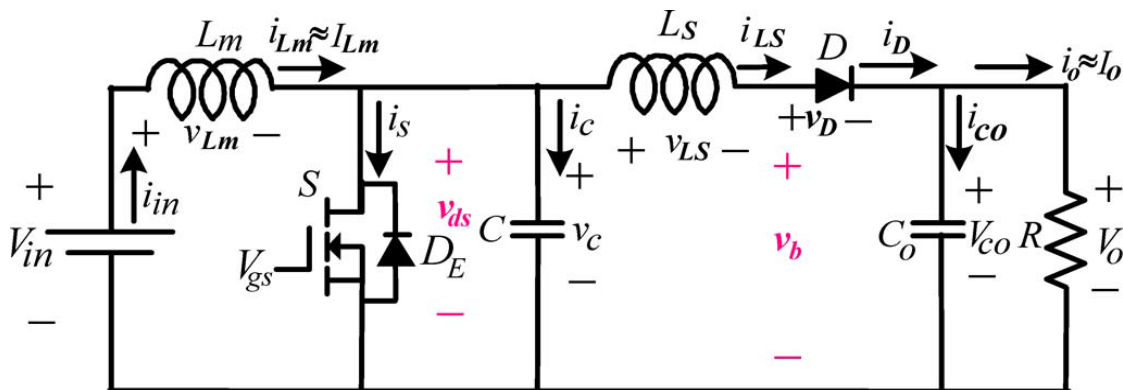


Fig: Basic Circuit Diagram Of A Single Switch Similar Resonant Power Converter

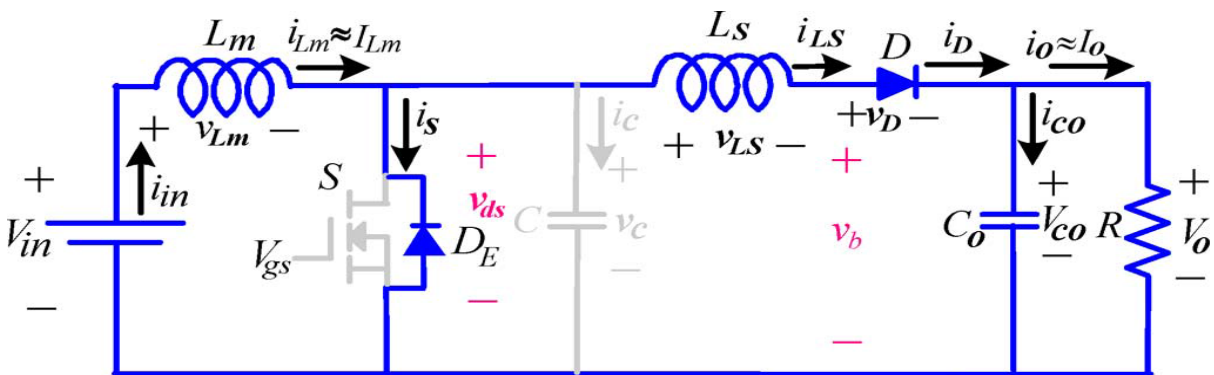


Fig: Equivalent Circuit of Mode I

Mode I-Between ωt_0 and ωt_1 : Prior to Mode I, the active power switch S is off. The resonant tank current i_{LS} is positive and exceeds the dc input current i_{Lm} . The power switch must be turned on only at zero voltage.

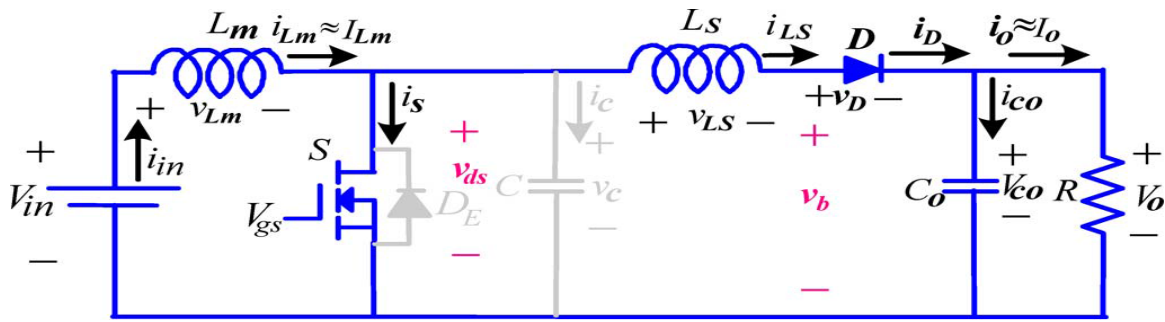


Fig: Equivalent Circuit of Mode II

Mode II-between ωt_1 and ωt_2 : In this period, the switch S remains in the ON state. Fig. 4 shows the equivalent circuit. The line voltage is applied to the choke inductor L_m , and i_{Lm} increases continuously.

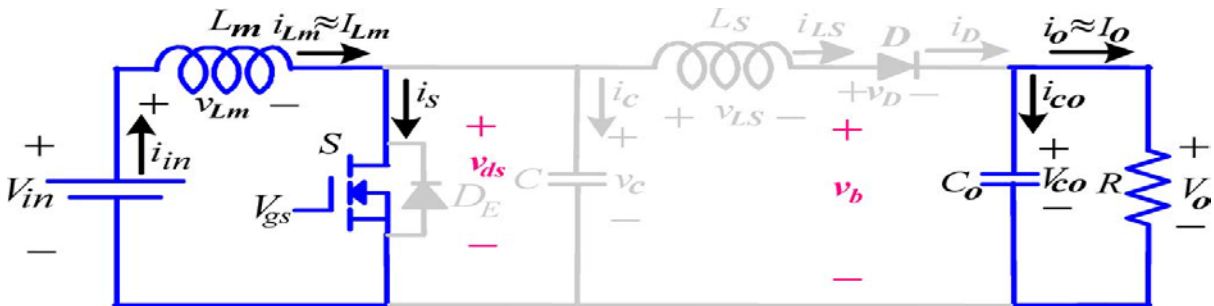


Fig: Equivalent Circuit of Mode III

Mode III-between ωt_2 and ωt_3 : In Mode III, the active power switch S remains in the ON state and the input dc current i_{Lm} continuously increases. The choke inductor current i_{Lm} flows through the active power switch S .

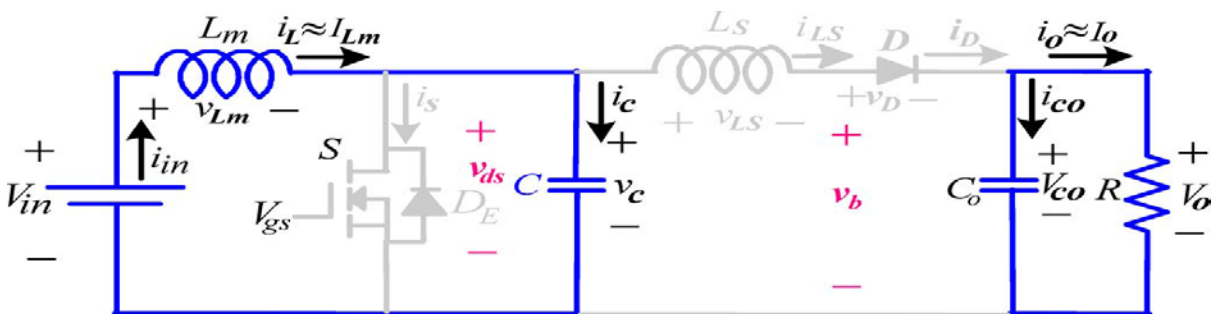


Fig: Equivalent Circuit of Mode IV

Mode IV-Between ωt_3 and ωt_4 : At the beginning of Mode IV, the active power switch S is switched off. The capacitor current i_C becomes i_{Lm} . Then, the capacitor voltage v_c rises from zero to a finite positive value. For ZVS operation, S is switched off at zero voltage, and the capacitor voltage v_c increases linearly from zero at a rate that is proportional to i_{Lm} .

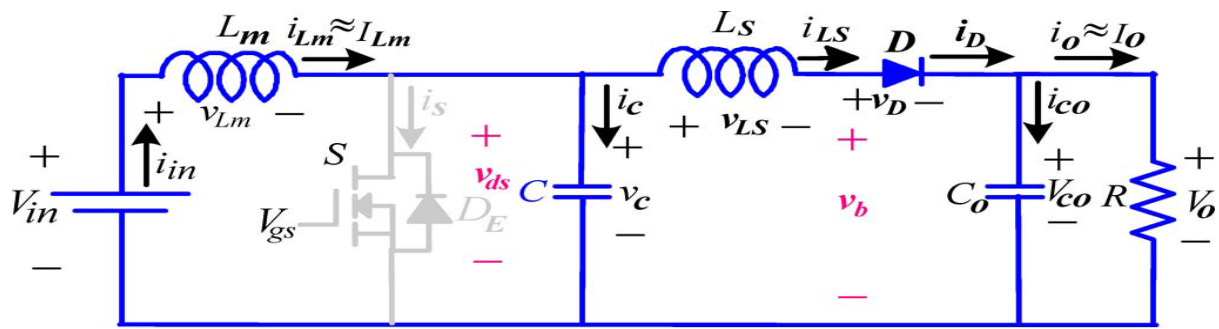


Fig: Equivalent Circuit of Mode V

Mode V-Between ωt_4 and ωt_5 : In Mode V, the active power switch S remains in the OFF state. The inductor current i_{LS} is positive, and the energy-blocking diode D is turned on, yielding a resonant stage between inductor L_s and capacitor C .

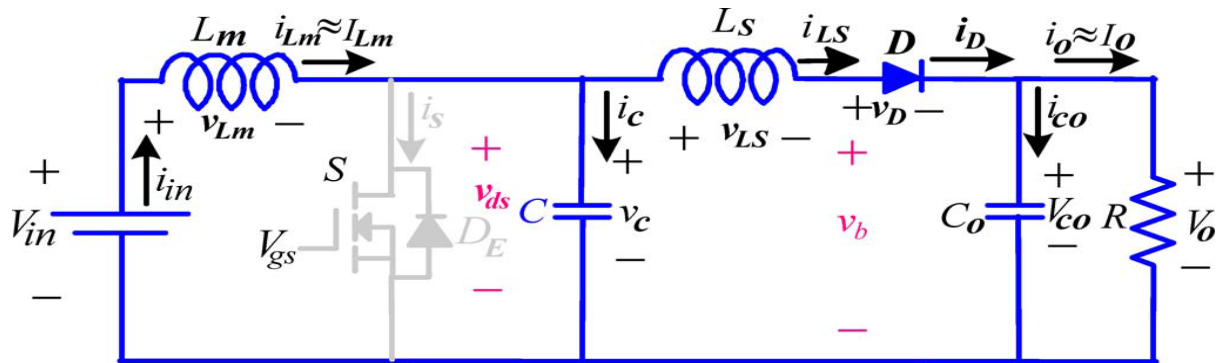


Fig: Equivalent Circuit of Mode VI

Mode VI-Between ωt_5 and 2π : This cycle begins at ωt_5 when capacitor voltage v_c resonates from negative values to zero [24]. The active power switch S is turned on when $\omega t = 2\pi$ to eliminate switching losses.

Matlab Results

A single-switch similar resonant power converter is designed and used in a renewable energy generation system as an example to demonstrate the relevant theory. The input of the proposed novel single-switch resonant power converter was connected to a small-scaled solar energy generation system that consisted of a dc source with an output voltage of 15 V.

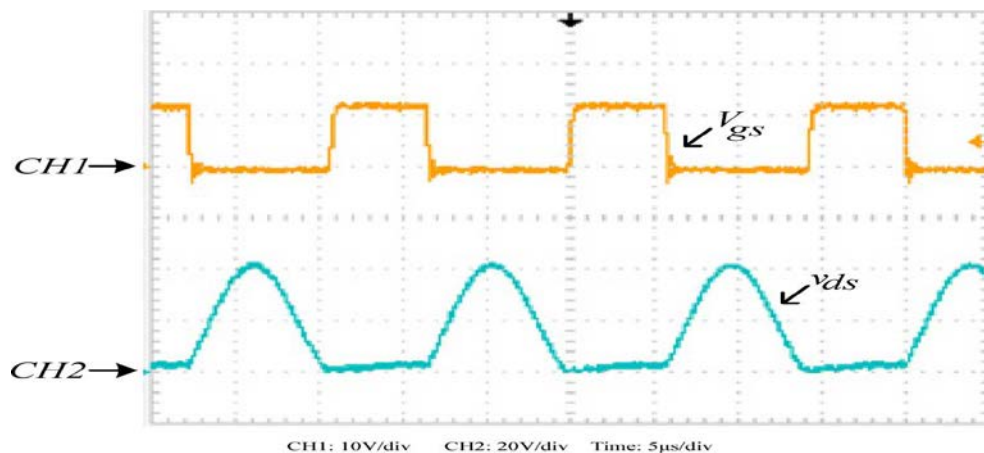


Fig: Trigger Signal And Voltage Waveforms Of The Active Power Switch.

The conduction losses of the new single-switch similar resonant power converter are proportional to the forward voltage of the energy-blocking diode. The losses can be reduced by applying Schottky diodes. To realize ZVS operation of the

active power switch and ZCS operation of the energy-blocking diode of this new converter, the switching frequency must satisfy $f_s < f_o$. The developed new single-switch similar resonant power converter is applied to a 10- Ω load resistor.

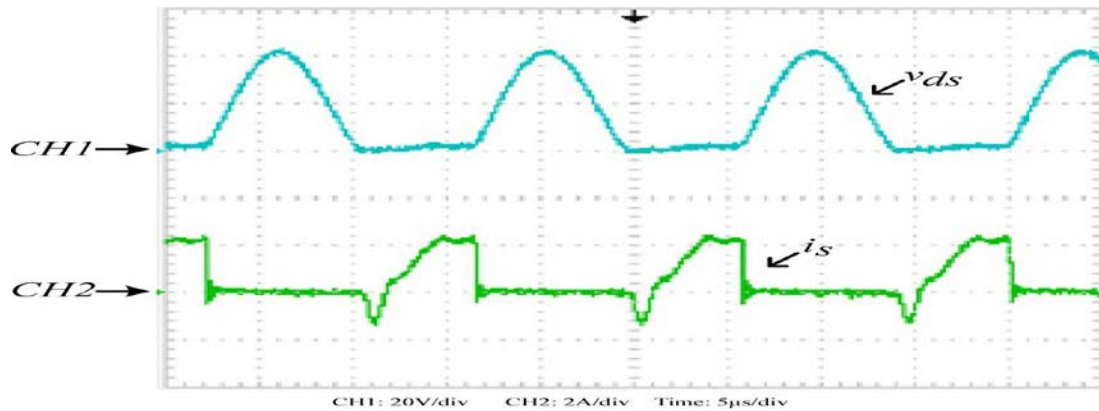


Fig :Voltage And Current Waveforms Of The Active Power Switch

To reduce the input current ripple and maintain the stability of the output voltage, the low-pass filters at the input and output terminals, which use a choke inductor and electrolytic capacitor, are set to $L_m = 8$ mH and $C_o = 220$ μ F, respectively. The low-pass filter is designed to be small, light, and low cost.

Conclusion

In this paper, a new single-switch similar resonant power converter with an energy-blocking diode has been designed for use in a solar energy generation system. The structure of the proposed converter is simpler and cheaper than other resonant power converters, which require numerous components. The novel resonant converter is analyzed, and performance characteristics are presented. The developed novel single-switch resonant power converter offers the advantages of soft switching, reduced switching losses, and increased energy conversion efficiency. The output power can be determined from the characteristic impedance of the resonant tank by adjusting the switching frequency of the converter. The new single-switch similar resonant power converter is supplied by a solar energy generation system to yield the required output conditions. The experimental results reveal the effectiveness of the developed novel single-switch resonant power converter in solar energy generation. When the high-frequency new single-switch similar resonant power converter is applied to a resistive load, the satisfactory energy conversion efficiency is 97.3%.

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