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Efficient Design to Meet High Power Density Applications Using DC-DC Energy Conversion

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Abstracts

In order to meet higher power applications in power electronics system this proposed with implantation using DC-DC energy conversion with resonant converter. Present generation there is a huge amount of markets has increased the demand for high efficiency and high power density applications. But Conventional adopted pulse width modulation includes small weight, low power, low efficiency, due to high switching frequencies in diodes. The proposed system implements a half-bridge inductor-capacitor, inductor (L-C-L) resonant converter. Output is proposed with low pass filter.

Keywords: Pulse width modulation, resonant converter.

Introduction

Resonant inverters are based on electrical to perform oscillations. It is known as DC-DC Converter or DC-PWM inverter. Main function is to reduce the switching losses of the device. As the immense use of the semiconductor power switches in power electronics technology has led to rapid development of this technology in very recent years. In Power energy conversion as switching power role is more mainly with DC-DC converters are used in industrial commercial places [1]. These converters are power electronics circuits that translate a DC voltage into a providing a regulated output. Power semiconductor, switches are the key component of power energy conversion systems by using the Pulse-width modulation (PWM) which is the simplest way to control power semiconductor switches and the PWM approach controls, power flow by interrupting current or voltage through means of switch action with control of duty cycles. Practically speaking a situation in which the voltage across or current through the semiconductor switch is suddenly interrupted is referred to as a hard-switched PWM due to its simplicity and ease in control as we know that the hard switched PWM schemes have been largely adopted in modern power energy conversion applications. Hence a large switch voltage and a large switch current stirring simultaneously requires the switch withstands elevated switching stresses in a safe operating area as shown by the dashed lines in Fig. 1.

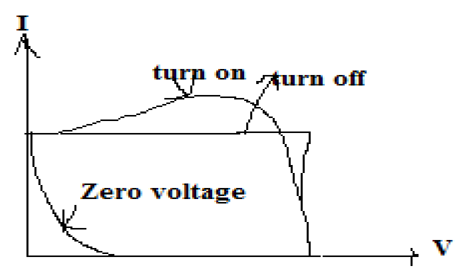

Fig 1.0 Characteristics of switching

Modern DC-to-DC power converters are small sized and light weight, have high energy conversion efficiency. A higher switching frequency implies smaller and lighter inductors, capacitors, as well as filter components of these converters. However, electromagnetic interference (EMI) and switching losses increase with an increasing switching frequency, ultimately decreasing the efficiency and performance of DC-to-DC power converters. To solve this problem, some soft switching approaches must operate under a high switching frequency. Zero voltage switched and zero current switched schemes are two commonly used soft switching methods, in which either the voltage or current is zero during switching transitions, which largely reduce the switching losses, EMI, and increase the reliability of the power converters. While attempting to devise DC-to-DC converters capable of operating at low switching losses, power electronics engineers started developing converter topologies that shape either a

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sinusoidal current or a sinusoidal voltage waveform. DC to DC converters are important in portable electronic devices such as phones and which are supplied with power. Such electronic devices often contain several circuits, each with its own voltage level requirement different from that supplied by the battery or an external supply (sometimes higher or lower than the supply voltage). Additionally, the battery voltage declines as its stored power is drained. Switched DC to DC converters offer a method to increase voltage from a partially lowered battery voltage thereby saving space instead of using multiple batteries to accomplish the same thing.dc-to-dc power conversion applications the parallel loaded resonant converter is generally suggested as the energy conversion stage due to its simple circuitry and typical input characteristics where as a large filter inductor to the output side of the bridge rectifier in a traditional parallel loaded resonant converter might add significant weight and volume and also cost which is based on the parallel loaded resonant converter and this paper presents a novel loaded resonant converter. The proposed solution for the problem space is superior to the conventional parallel resonant converter in terms of miniaturization in terms of size or light weight or its simple topology and easy control. A broader classification of resonant type DC-to-DC converter is used:

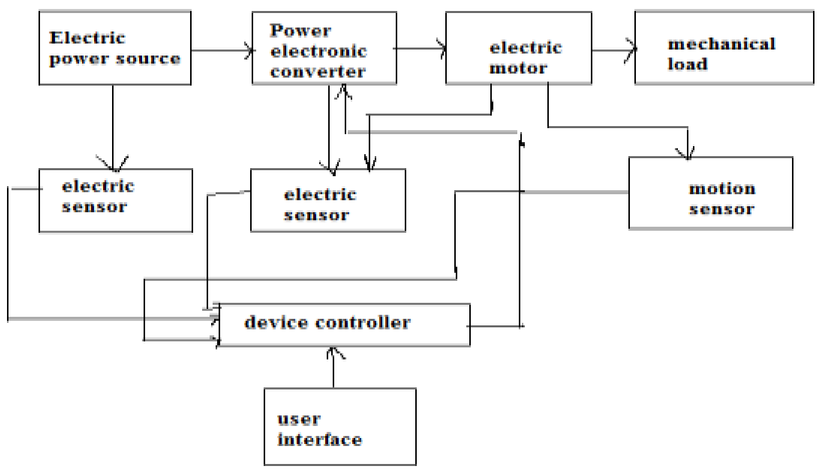

Fig 2.0 classification of DC-DC converter

A Circuit diagram

Load resonant converter

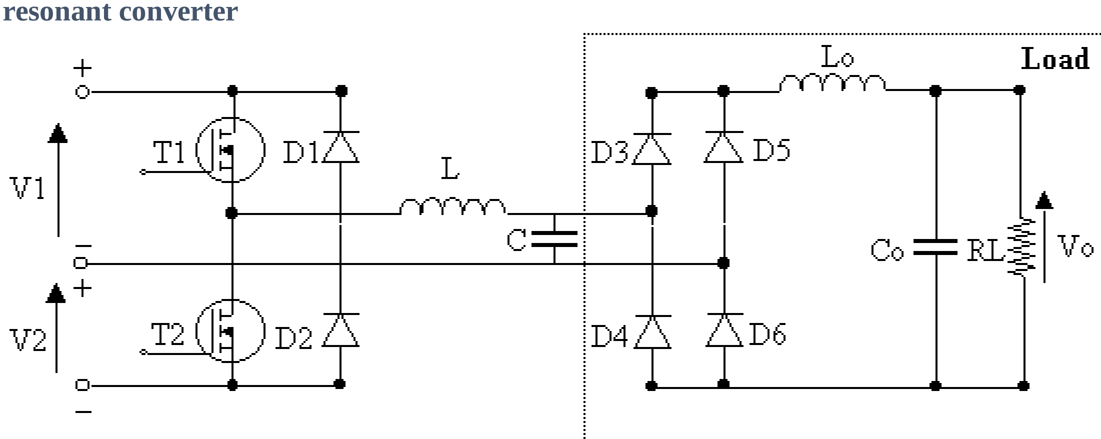

Fig 3.0 load resonant converter

The two transistors, *T1* and *T2*, on the input are large and split the voltage of the input DC source. The elements *Lr*1, *Lr*2, and *Cr* from the resonant tank. The load resistance *RL* is connected across a bridge rectifier via a low-pass filter capacitor *Co*. For analysis, the power switching devices are assumed here to be represented by a pair of bidirectional switches operating at a 50% duty ratio over a switching period *T*. For the half-bridge topology, each bidirectional power switch has an active power switch and an ant parallel diode. The active power switches are driven by no overlapping rectangular-wave trigger

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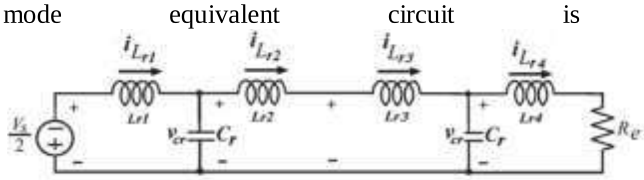
signals *vGS*1 and *vGS*2 with dead time. Thus, we may represent the effect of the power switches by means of an equivalent square wave voltage source with an amplitude equal to • } *Vs/*2. Resonant inductor current *iLr*2 is rectified to obtain a DC bus. The DC bus voltage can be varied and closely regulated by controlling the switching frequency. Because of that, the AC-to-DC power conversion, in this case, is achieved by rectifying the current through resonant inductor *Lr*2, a large filtering capacitance *Co* is needed not only to minimize the loading effect of the output circuit, but also to ensure that the voltage across it is mostly constant. Consequently, the voltage across the bridge rectifier has constant amplitudes +*Vo* and −*Vo*, depending on whether the current *iLr*2 (*t*) is positive or negative, respectively. The frequency of this voltage waveform is the same as that of the switching frequency. Based on the above observations, the novel loaded-resonant converter can be modeled as a series *Lr*1 − *Cr* − *Lr*2 circuit and a square-wave voltage source*Vo* in series with the resonant inductor *Lr*2. Fig. 3 shows the simplified equivalent circuit for the proposed loaded-resonant converter.

Operating characteristics

The novel loaded-resonant converter for the application of DC-to-DC energy conversion application system is shown in Figure. 3 where the switching frequency of the active power switches is predicted to be greater than the resonant frequency so that the resonant current is uninterrupted with a large capacitive filter at the output terminal of the bridge rectifier where the output voltage may be predicted to be constant for providing the analysis of the operation of the novel loaded resonant converter where the circuit in Fig. 3 can be simplified to a schematic circuit as shown in Fig. 4 since the output voltage is assumed to be a constant Vo then the input voltage of the bridge rectifier vb is Vo when iLr2 is positive and is −Vo when iLr4 is negative then the input part of the novel loaded-resonant converter for the application of dc-to-dc energy conversion comprises of a dc input voltage source Vs and a collection of power switches where the active power switches are controlled for producing a square-wave voltage va since a resonant circuit forces a sinusoidal capability of transferring the power of the fundamental component from the input source to the resonant circuit because it is sufficient to consider only the fundamental component of this converter where the novel loaded-resonant converter with a bridge rectifier stage for dc-to-dc energy conversion system is analyzed by taking into consideration of the fundamental frequency of the Fourier series transformation for the voltages and currents where the error rate due to this approximation is very small and if the switching frequency is higher than the resonant frequency and the fundamental mode equivalent circuit is



Experimental results

A prototype was constructed and implemented in academic by taking many samples by varying inputs to demonstrate the effectiveness of the proposed loaded-resonant converter. The developed topology was connected to a 24-V DC source. Table I lists the circuit parameters for the proposed loaded-resonant converter where the circuit simulations are also performed using MATLAB software in addition to this the proposed loaded-resonant converter was implemented in practice and finally the simulation and practical results were compared with each other.

Figure

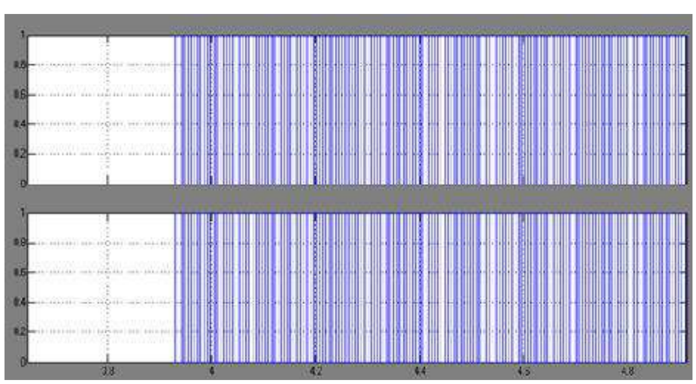


Fig 4.0input signals

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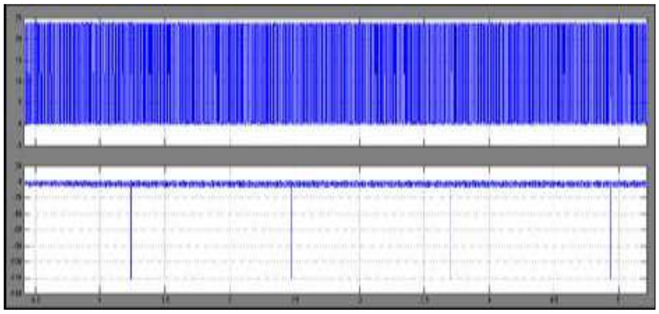

Fig 5.0 measured voltage signal

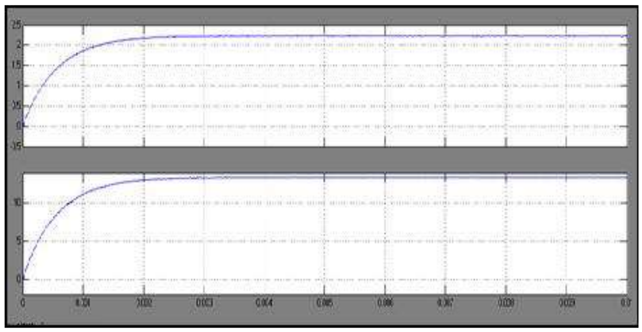

fig 6.0 output signal

Conclusion

In the proposed system which we proposed the circuit structure is very simpler and less expensive than other control mechanism that requires many components and the developed topology is characterized by zero voltage switching or reduced switching losses and increased energy conversion efficiency where the output voltage/current can be determined from the characteristic impedance of the resonant tank by adjusting the frequency of the converter whereas the proposed loaded-resonant converter is applied to a load in order to yield the required output conditions. All the experimental results demonstrate the effectiveness of the proposed converter where the energy conversion efficiency is 88.5% which is quite satisfactory when the proposed loaded-resonant circuit operating above resonance is applied to a dc-to-dc converter where as in contrast with the conventional parallel-loaded-resonant converter the energy conversion efficiency can be improved using the proposed topology and excellent performance can be achieved at a lower cost and with fewer circuit components than with the conventional converter.

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