LLC RESONANT CONVERTER FOR STREET LAMP

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Abstrak

Tulisan ini menyajikan penggunaan LLC Resonant Converter dalam bentuk simulasi untuk lampu jalan yang dimodelkan sebagai beban resistif. Rangkaian ini diharapkan berguna untuk mengkonversi daya listrik dari tegangan arus searah dengan amplitudo yang rendah ke tegangan yang lebih tinggi. Selama percobaan simulasi ini, inverter sebagai setengah jembatan dikombinasikan dengan LLC konverter resonan untuk menyuplai penyearah dan beban resistif. LLC konverter resonan terdiri dari induktor, kapasitor dan transformator frekuensi tinggi. Frekuensi operasi dilakukan di dekat frekuensi resonansi. Hasil percobaan menunjukkan bahwa topologi ini mampu untuk meningkatkan tegangan dari 15 volt to40 volt sebagaimana yang dibutuhkan oleh beban.

Kata kunci: Konverter resonan, LED, inverter

Abstract

This paper is present the use of LLC Resonant Converter in simulation to supplied Street Lamp modelled as resistive load. The circuit is expected useful to convert the electrical power from lower dc voltage to higher amplitude. During the simulation experiment as half bridge inverter was combined with LLC resonant converter to supply the rectifier and resistive load. The LLC resonant converter consist of inductor, capacitor and high frequency transformer. The operation frequency was carried out near resonance. The result shows that the topology is promising to step up voltage from 15 volt to40 volt as it is required by the load.
(Times New Roman 10)

Keywords: Resonant converter, LED, inverter

1. Introduction

Solar panels produce electrical energy in the form of DC and where there may be a need to change the values magnitude of voltage and current to suit the requirements the load, from the piece highlights the need to use system as mediators between the sources and load[1, 2]. In this work, LLC is used as resonant circuit in power converter system. This kind of LLC is expected to have good efficiency and low circulating energy and low switching loss[3-6].

In this paper several works will be delivered as follow:

1. The configuration of inverter with LLC circuit:
2. The representation of the load i.e. light emitting diode. This LED is possible to use lighting in the streets. The number of LEDs used in the fixture is an extremely important variable to be considered in the project of the lighting system, once both the designs of the photovoltaic solar panels and battery bank are dependent of this number.

In this paper, the lighting system will consist of several blocks as depicted in the Figure (1).

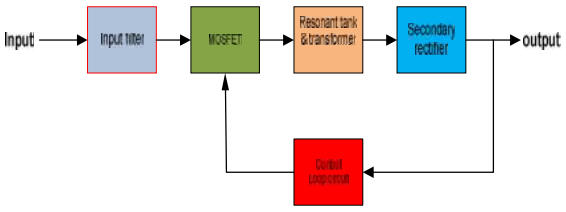

Figure (1) Block diagram for lighting sysyem LLC converter

2. Method

The inverter with LLC resonant circuit composed of three basic components are the resonant inductor Lr and resonant capacitor Cr are in series and Lm in parallel as shown in Figure 1.

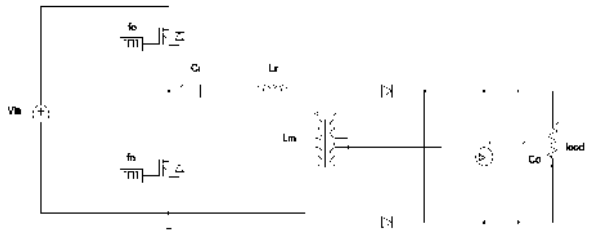

Figure 1. The inverter with LLC resonant circuit

To find the equivalent circuit for the circuit in Figure 1 must make some approximations which facilitates the calculation equivalent circuit and it not affect the accuracy like ignore the effect from the output capacitor and the transformer 's secondary-side leakage inductance, also ignoring all higher-order harmonics resulting from the voltage source with square wave. With these approximations can be obtained on the equivalent circuit as shown in Figure.2.

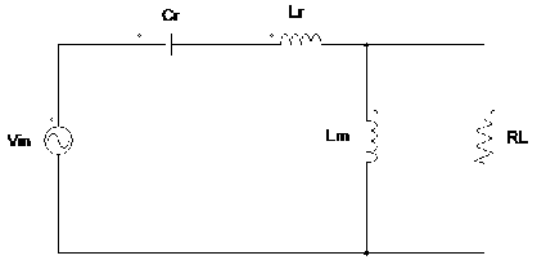

Figure.2 Equivalent circuit of LLC resonant

By using frequency sweep program in Microsim [7, 8], the simulation circuit of LLC resonant circuit is shown in Figure 3

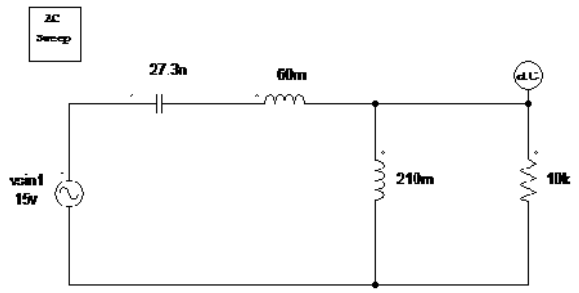

Figure 3. LLC resonant circuit

The result os ac sweep program is illustrated in Figure 4. In the result, it is shown that the resonant frequency is possible to be achieved at 185 kHz. The resonant frequency is possible to be observed by the maximum amplitude voltage.

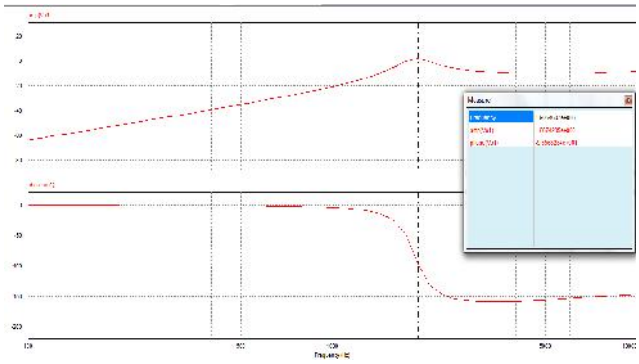

Figure 4. The simulation result to obtained resonant frequency

3. Experiment Circuit and Results

Based on the result obtained in Figure 4, then the inverter circuit in Figure 1 is triggered by set the operation frequency at resonant frequency i.e. 185 kHz. Two MOSFET are required in this inverter, so the sequence of switching between two switched must be at leas 180^{o} degree different. The complete circuit simulated in Power Simulator version 7.0 is shown in Figure 5.

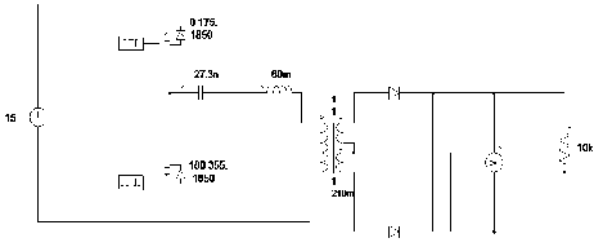

Figure 5. The complete circuit of inverter simulated in PSIM

Based on Figure 5, the LED load is represented by resistive load. This load is supplied by the output of inverter through high frequency two diodes. This method was carried out to provide direct current for LED, because the load was only work as it was supplied by dc voltage. The illustration of voltage at load side is shown in Figure 6. The dc output reached 40 Volt as the input side is 15 Volt.

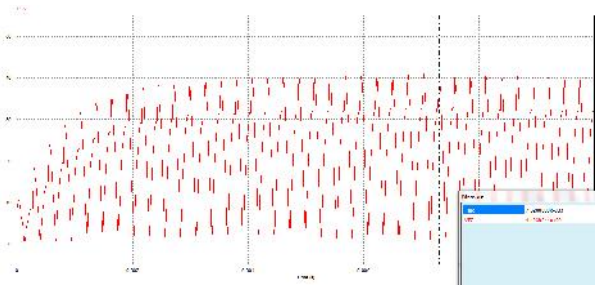

Figure 6. The load voltage

During the experiment based on PSIM, the load was varied to observe the output voltage at load side. As the value of resistive load decrease then the load voltage will be follow to decrease. The result of simulation in Figure 7 shows that more power will be required as the value resistance as load was reduce. The output voltage can not stand for further load increment because the power was limited by the converter.

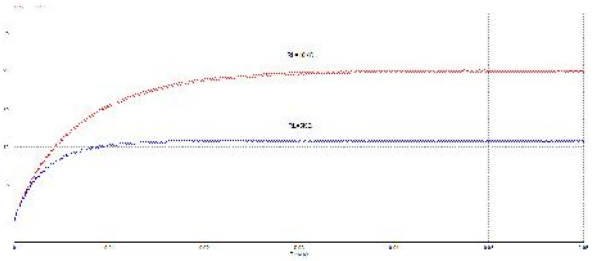

Figure 7. The load voltage as the function of variable resistive load

4. Conclusion

Based on the simulation conducted, then several conclusion are taken as follow:

1. The topology of LLC resonant converter was successfully simulated with half bridge inverter to convert lower dc voltage to higher output voltage.
2. The use of resonant principle is considered effective to step up the voltage and provide the desired voltage.
3. As the load increase the output voltage follow to decrease, so there is further development that must be carried out to maintain the load voltage.

Referensi

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