Power Electronics

Boost Converter

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**Question 1**. From the PSIM Circuit of the Boost converter shown in Fig. 2, the inductor current has . It is operating in dc steady state under the following conditions: , , , and .

(a) Assuming ideal components, calculate L and draw the waveforms of duty, MOSFET voltage, inductor voltage, inductor current, diode current and capacitor current.

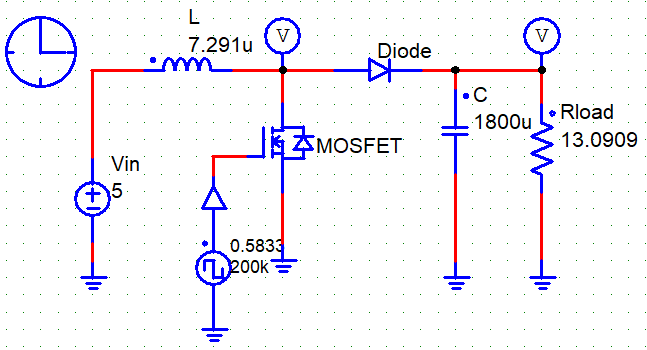


Figure 1. Circuit of Boost Converter

차트이(가) 표시된 사진

자동 생성된 설명

Figure 2. waveforms of duty

차트이(가) 표시된 사진

자동 생성된 설명

Figure 3. waveforms of MOSFET Voltage

차트이(가) 표시된 사진

자동 생성된 설명

Figure 4. waveforms of Inductor Voltage

차트이(가) 표시된 사진

자동 생성된 설명

Figure 5. waveforms of Inductor Current

차트이(가) 표시된 사진

자동 생성된 설명

Figure 6. waveforms of Inductor Current

차트이(가) 표시된 사진

자동 생성된 설명

Figure 7. waveforms of MOSFET Current

The equations and graphs above indicate that the theoretical values of voltage and current for the devices in the boost converter circuit are consistent with the simulation values.

**Question** **2.** In a Boost converter, . It is operating in dc steady state under the following conditions: , D = 0.4, , and . Assume ideal components. Calculate the critical value of the output load and below which the converter will enter the discontinuous conduction mode of operation.

To enter DCM of operation,

**Question** **3.** In the Boost converter from problem 2, the input voltage is varying in a range from 9V to 15 V. For each input value, the duty-ratio is controlled to keep the output voltage constant at its nominal value (with = 12 V and D = 0.4). Calculate the critical value of the inductance L such that this Boost converter remains in the continuous conduction mode at and above = 5 W under all values of the input voltage . (Check Appendix )

To remain CCM of operation,

The value we want to find is the value of L that operates as a CCM in all intervals of 9[V] ≤ ≤ 15[V] when =5[W], so finding the maximum value of L will satisfy the conditions in all intervals.

The maximum value is the point where the gradient of the derivative becomes zero,

Using MATLAB, we can also find the solution.

차트이(가) 표시된 사진

자동 생성된 설명

Figure 8. MATLAB Results about

텍스트이(가) 표시된 사진

자동 생성된 설명

Figure 9. MATLAB Results about Question 3

**Question** 4**.** A Boost converter is to be designed with the following values: = 5 V, = 12 V, and the maximum output power = 40 W. The switching frequency is selected to be = 400 kHz. Assume ideal components. Estimate the value of L if the converter is to remain in CCM at one-third the maximum output power.

To remain CCM of operation,