DC/DC Converters

**Contents**

[1. Buck Converter 2](#_Toc123755579)

## Buck Converter

A step-down DC/DC converter will be used in regulated power supply. The specifications are; the input voltage range is 12-24 V and the output voltage is fixed at 5 V. The output voltage control is maintained by means of feedback control. The switching frequency is selected as 500 kHz. The L and C filter components are given as 5 µH and 10 µF. Assume ideal components, ignore all parasitic effects and assume ideal switches.

**a)** Find the load current that guarantees CCM operation under all operation conditions. Don't just use the formula; derive your steps.

**b)** Assume that rated output power is 15 W. Calculate the maximum inductor current ripple and output voltage ripple for the given input voltage range.

**c)** Simulate the steady-state behaviour of the converter and show the important waveforms for boundary conduction mode with 24 V of input voltage. Plot following waveforms and comment on the results.

* Inductor voltage and current
* Output voltage
* Diode voltage and current
* Switch voltage and current

**d)** Repeat part-c with 12 V input and 1 W output power. Comment on the results.

**e)** What is inrush current, define it. Considering the case in part-d, what is your inrush current at input current for this case. Propose a method to avoid inrush current and implement your solution to your simulation model. Compare the results by plotting the cases in this part and part-d.

**f)** Now, consider that the output capacitor has 50 mΩ ESR. Simulate the converter for boundary conduction mode with 24 V of input voltage. Compare the results with ideal case of part-c. Comment on the effect of adding capacitor ESR to the converter parameters such as output voltage ripple. Also, offer a solution to decrease the equivalent ESR of the output capacitor and to reduce the output voltage ripple.

a)