BUCK CONVERTER

Circuit Simulation done by

J. Leon Bosco Raj, Assistant professor,

Department of EEE,

St. Xavier's Catholic College of Engineering, Nagercoil.

Theory

The step-down dc-dc converter, commonly known as a buck converter, is shown in Fig. 1. It consists of dc input voltage source V_s, controlled switch S, diode D, filter inductor L, filter capacitor C, and load resistance R. The output voltage and current waveforms of the circuit (Fig. 1) are shown in Fig. 2. The output voltage is same as the input voltage, i.e., $V_0 = V_s$, when the switch is ON, during the period, $T_{ON} \geq t \geq 0$. The switch is turned on at $t = 0$, and then turned off at $t = T_{ON}$. This is called ON period. During the next time interval, $T \geq t \geq T_{ON}$, the output voltage is zero, i.e., $V_0 = 0$, as the diode,D_F now conducts. The OFF period is $T_{OFF} = T - T_{ON}$, with the time period being $T = T_{ON} + T_{OFF}$. The frequency is $f = \frac{1}{T}$. With T kept as constant, the average value of the output voltage is,

$$V_0 = kV_S$$

The duty ratio is $k = \frac{T_{ON}}{T} = \frac{T_{ON}}{T_{ON}+T_{OFF}}$

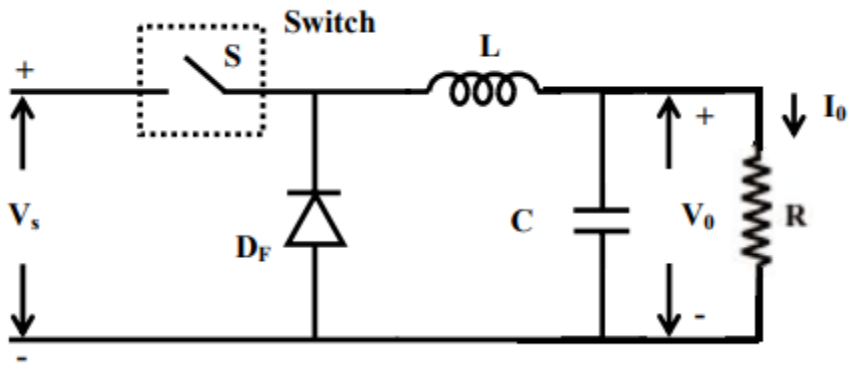

Figure: 1 Circuit diagram of Buck converter

Note: $\mathbf{R = 500\Omega, L = 1.4583\mu H, C = 200\mu F}$

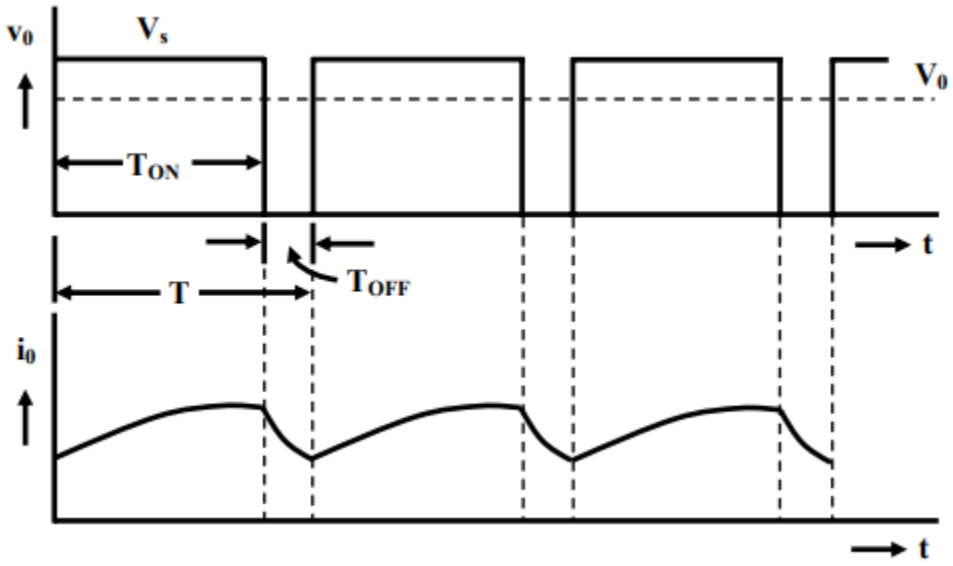

Figure: 2 Wave form of buck converter

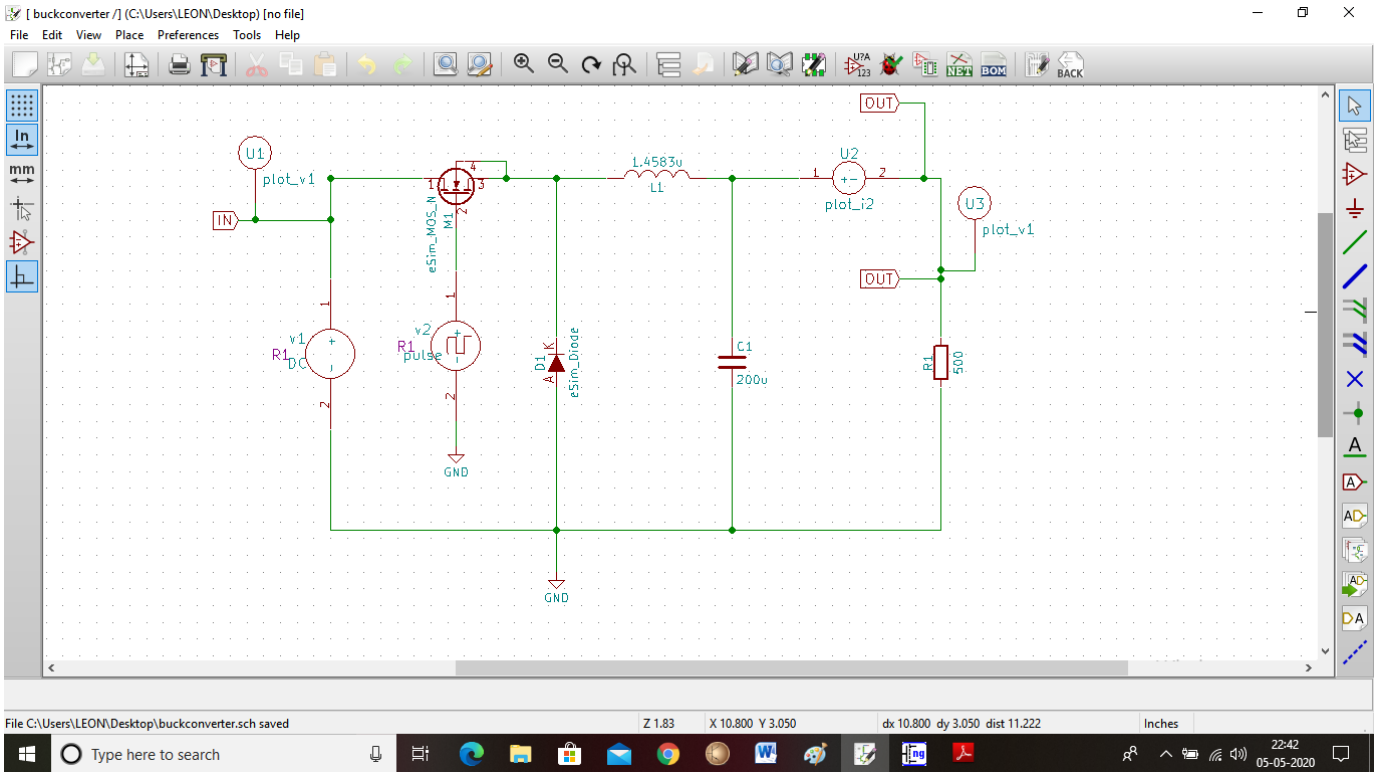

Figure 3: Schematic view of Buck converter in eSim

Simulation results

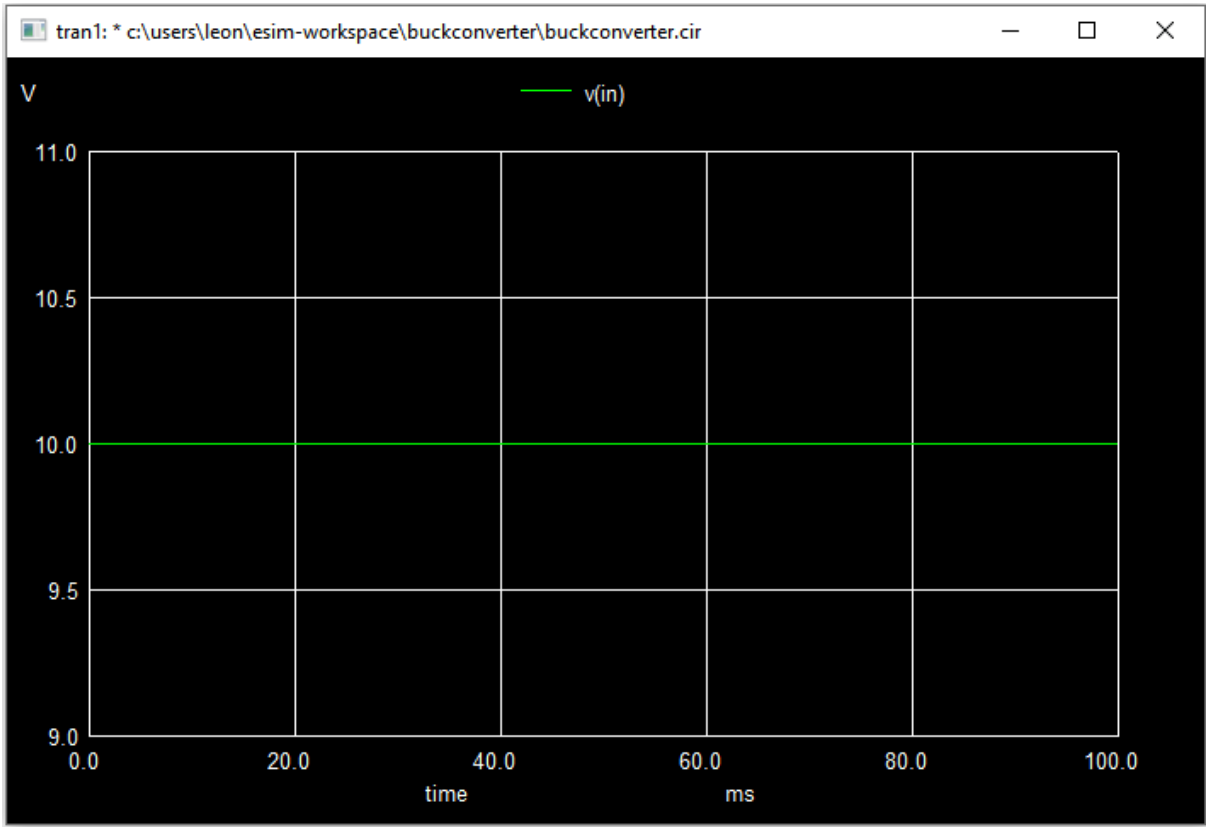

Figure 4: Input voltage wave form

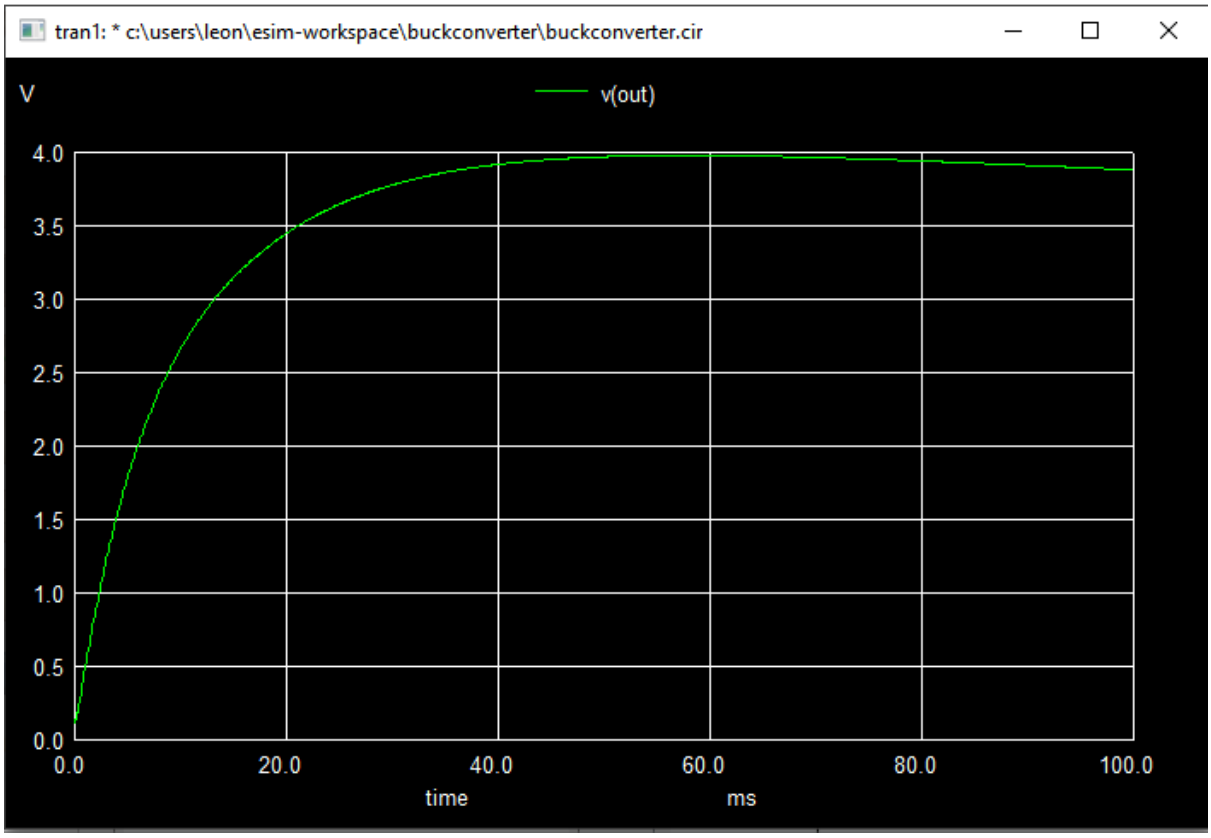

Figure 5: Output voltage wave form

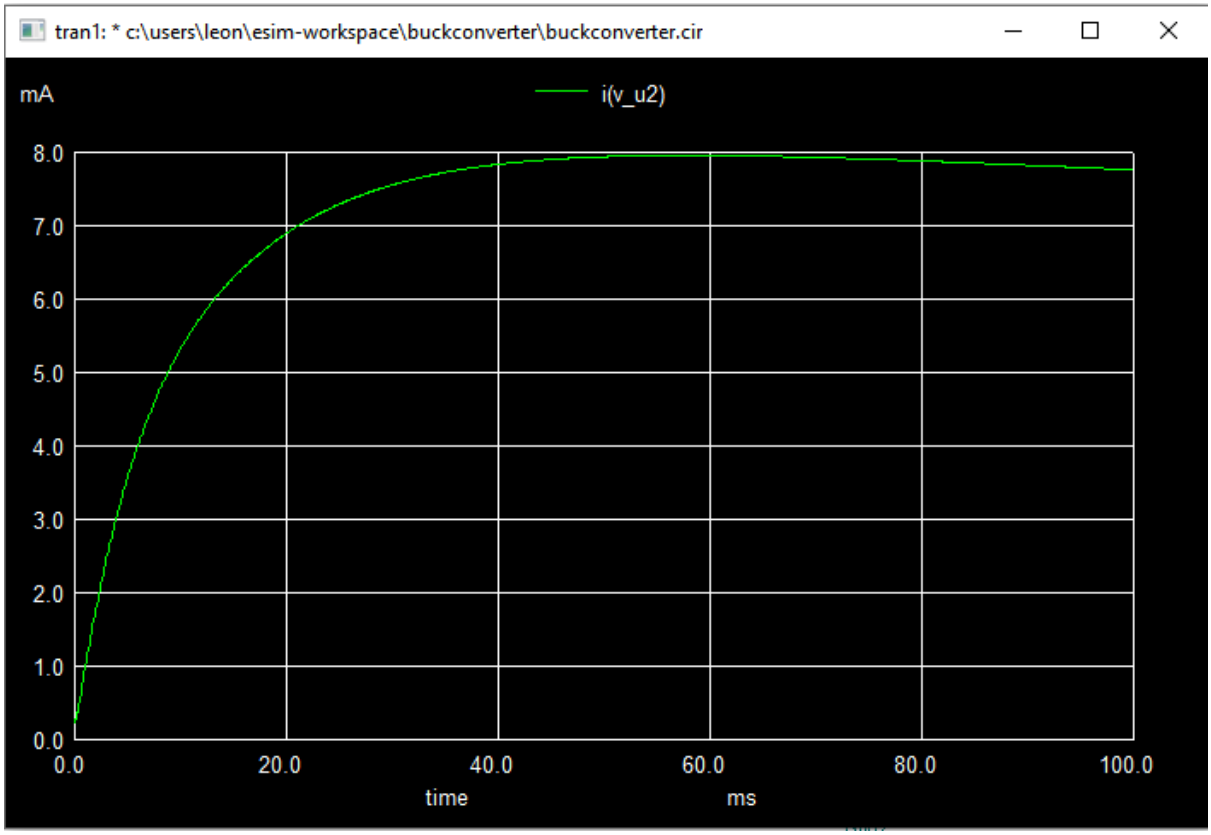

Figure 6: Output Current wave form

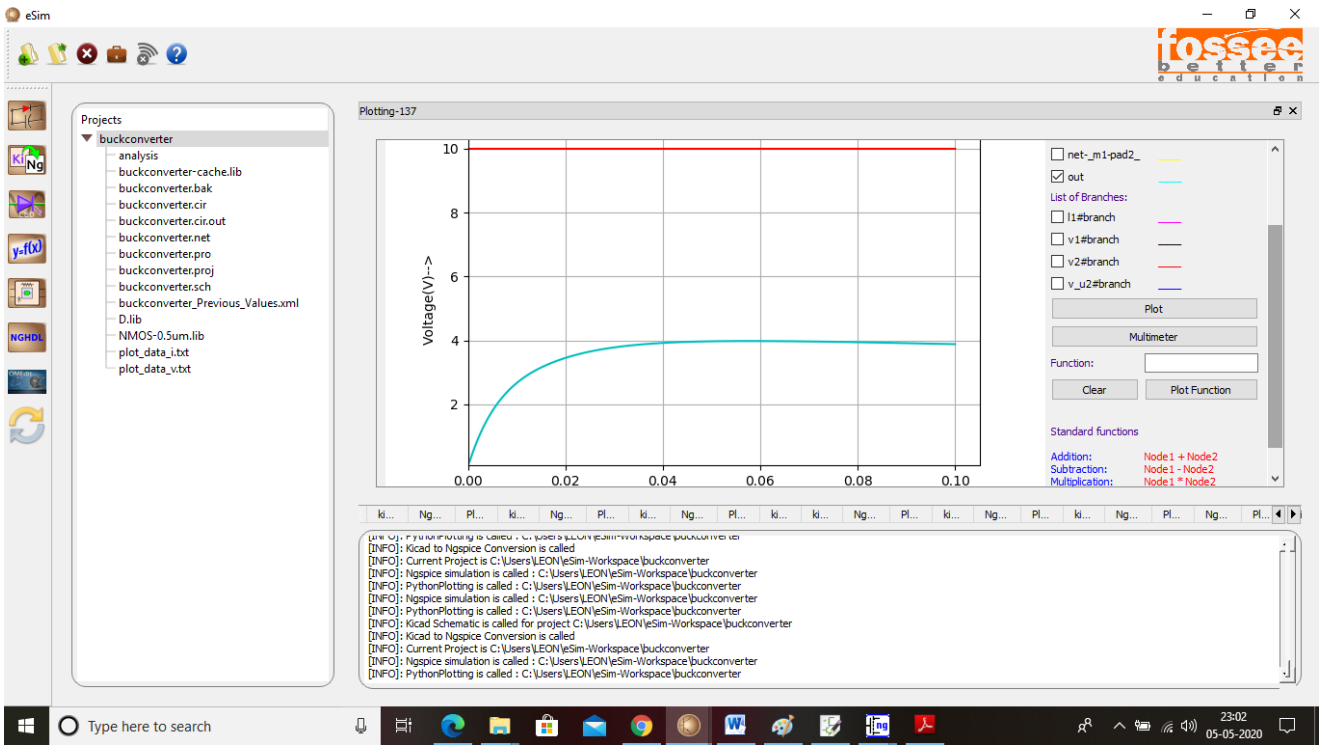

Figure 7: Python plot for input and output voltage waveform

Reference

https://nptel.ac.in/courses/108/105/108105066/ (NPTEL, Power electronics (Web), Lec: 17)