BOOST CONVERTER

Circuit Simulation done by

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Theory

A boost converter (dc-dc) is shown in Figure. 1. Only a switch is shown, for which a device belonging to transistor family is generally used. Also, a diode is used in series with the load resistance. The load is of the same type as given earlier. The inductance of the load is small. An inductance, L is assumed in series with the input supply. The operation of the circuit is explained. Firstly, the switch, S (i.e., the device) is put ON (or turned ON) during the period,$T_{ON} \geq t \geq 0$, the ON period being T_{ON}. The output voltage is zero ($V_o = 0$), if no battery (back emf) is connected in series with the load, and also as stated earlier, the load inductance is small. The current from the source (i_s)flows in the inductance L. The value of current increases linearly with time in this interval, with $\left(\frac{di}{dt}\right)$being positive. As the current through L increases, the polarity of the induced emf is taken as say, positive, the left hand side of L being +ve. The equation for the circuit is,

$$V_s = L\frac{di_s}{dt} \qquad or\, \frac{di_s}{dt} = \frac{V_s}{L}$$

The switch, S is put OFF during the period, $T \geq t \geq T_{ON}$, the OFF period being $T_{OFF} = T - T_{ON}$.$(T = T_{ON} + T_{OFF})$ is the time period. As the current through L decreases, with its direction being in the same direction as shown (same as in$\frac{di_s}{dt}$ the earlier case), the induced emf reverses, the left hand side of L being -ve. So, the induced emf (taken as –ve in the equation given later) is added with the supply voltage, being of the same polarity, thus, keeping the current $(i_s = i_0)$in the same direction. The current $(i_s = i_0)$ decreases linearly in the time interval,T_{OFF} , as the output voltage is assumed to be nearly constant at $v_0 \approx V_0$, with $\left(\frac{di_s}{dt}\right)$ being negative, as $V_S < V_0$, which is derived later.

The equation for the circuit is,

$$V_S = V_0 + L\frac{di_s}{dt}$$

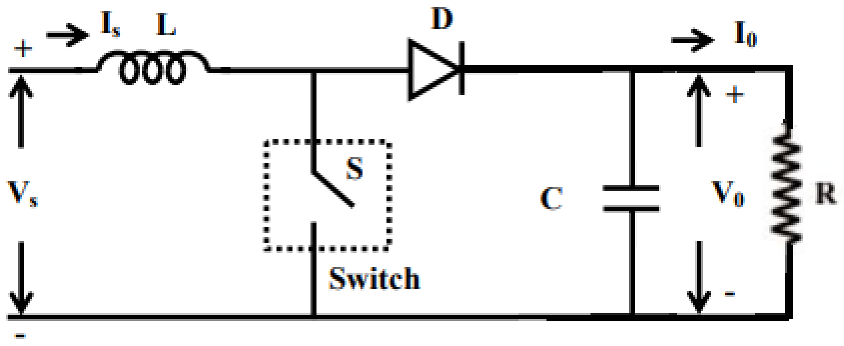

Figure 1 Circuit diagram of boost converter

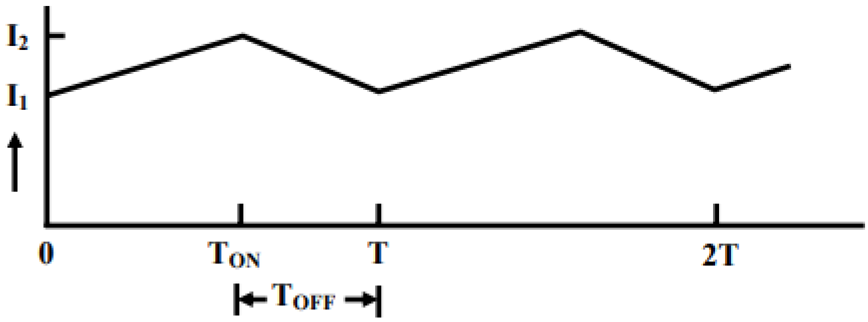

Figure 2 Wave form of boost converter

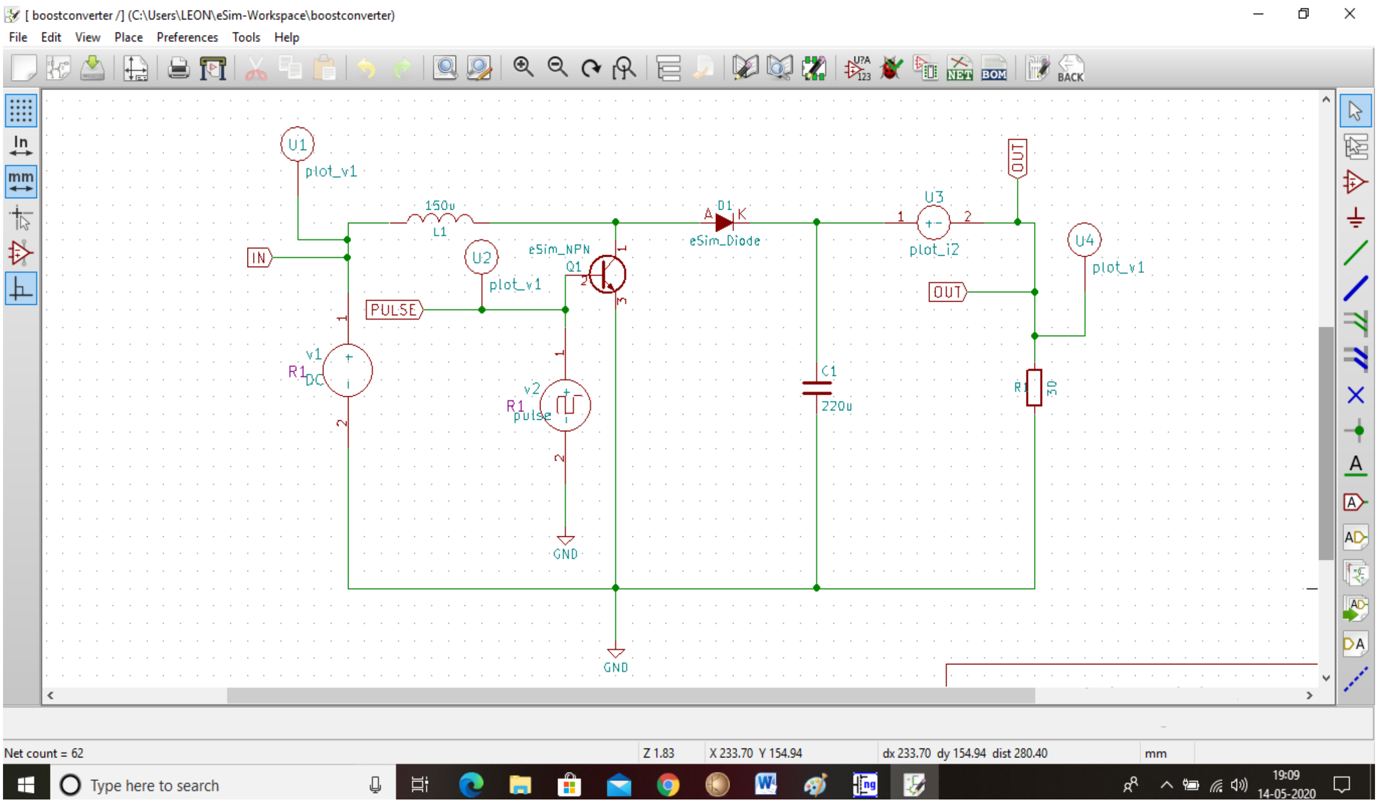

Figure 3: Schematic view of Boost converter in eSim

Simulation results

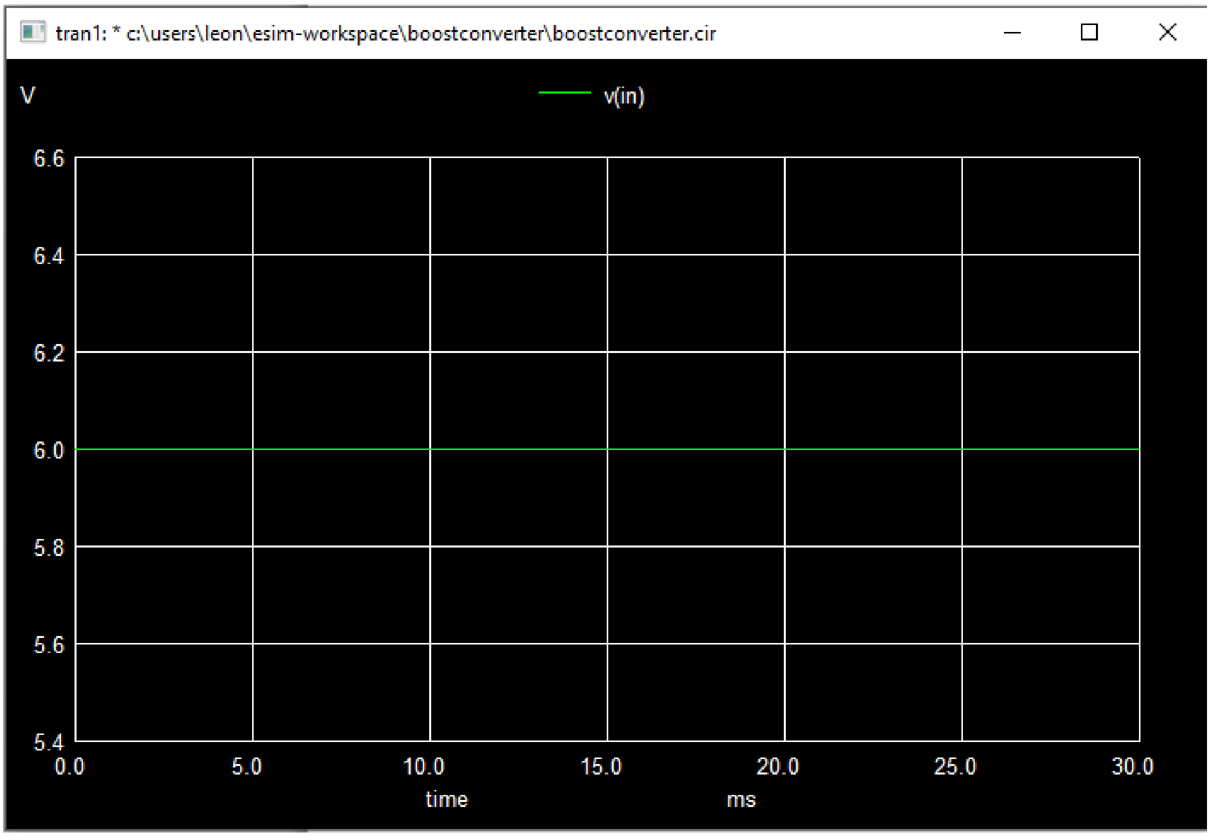

Figure 4: Input voltage wave form

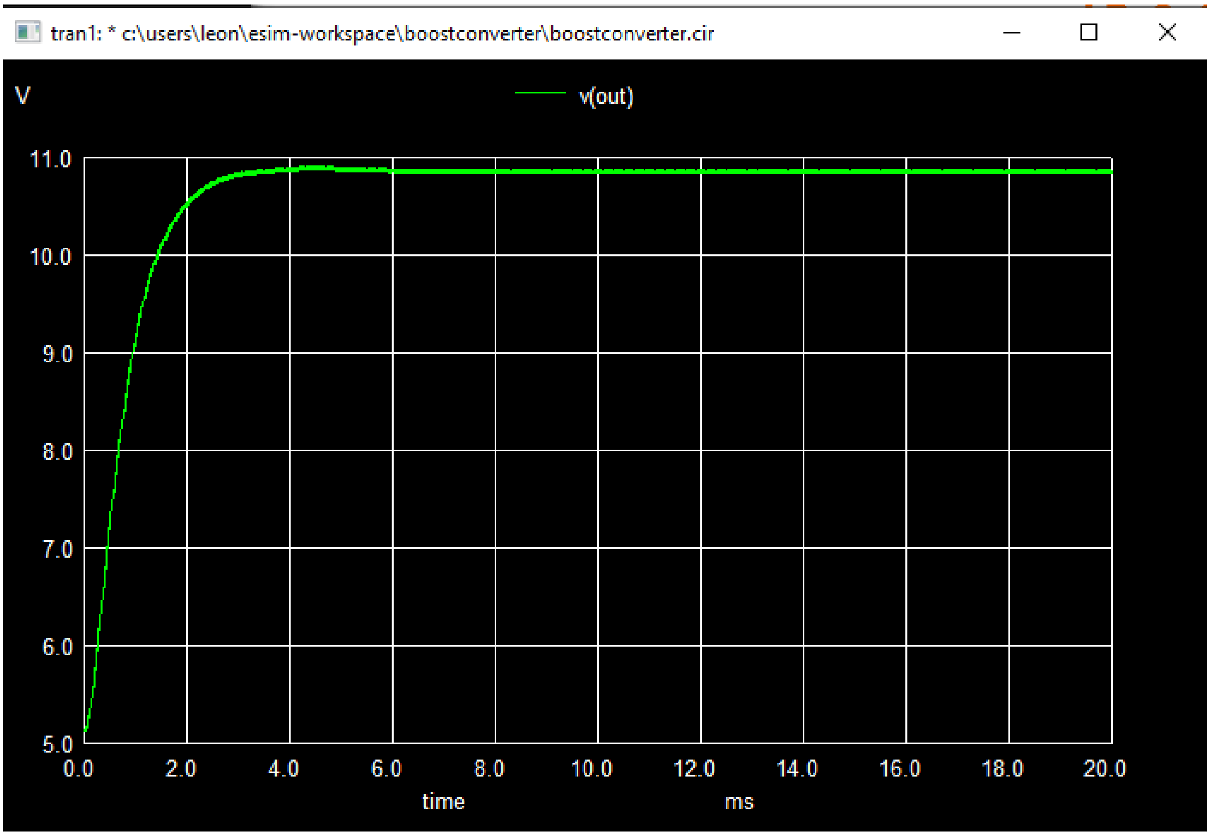

Figure 5: Output voltage wave form

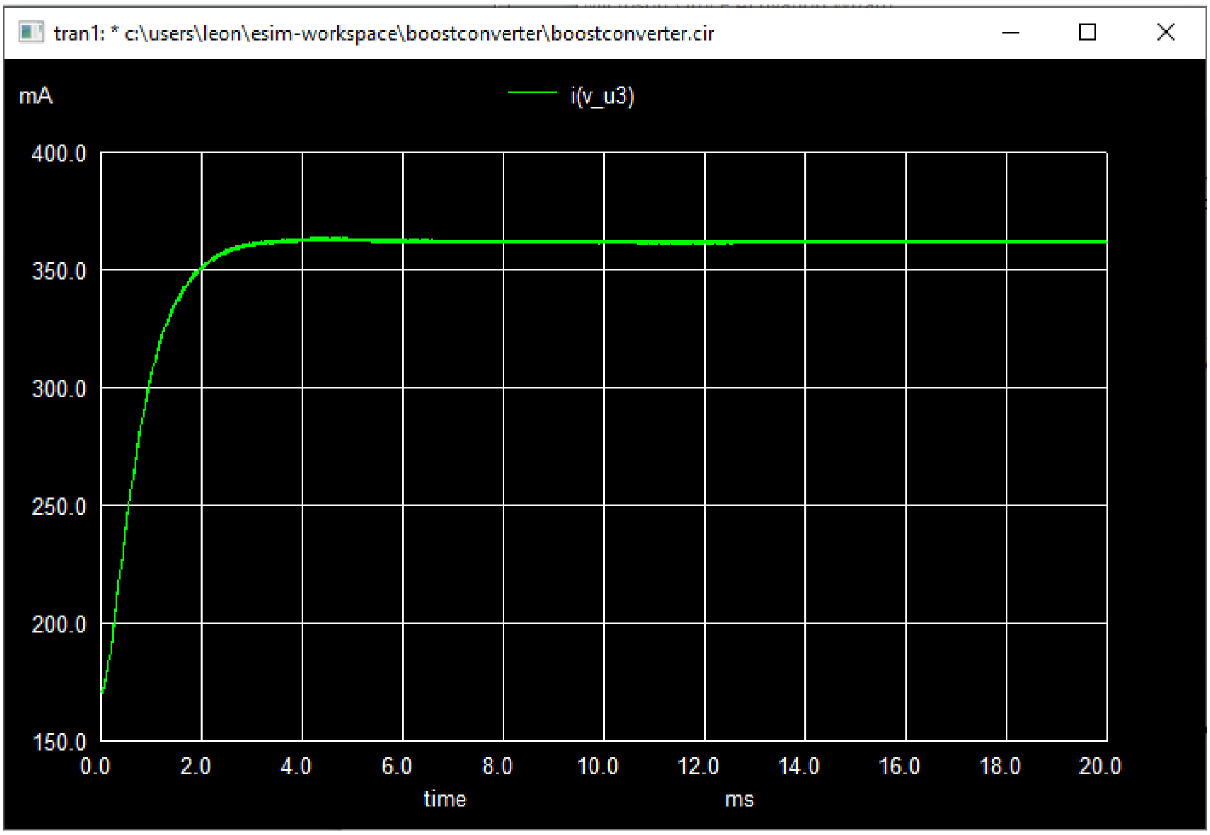

Figure 6: Output Current wave form

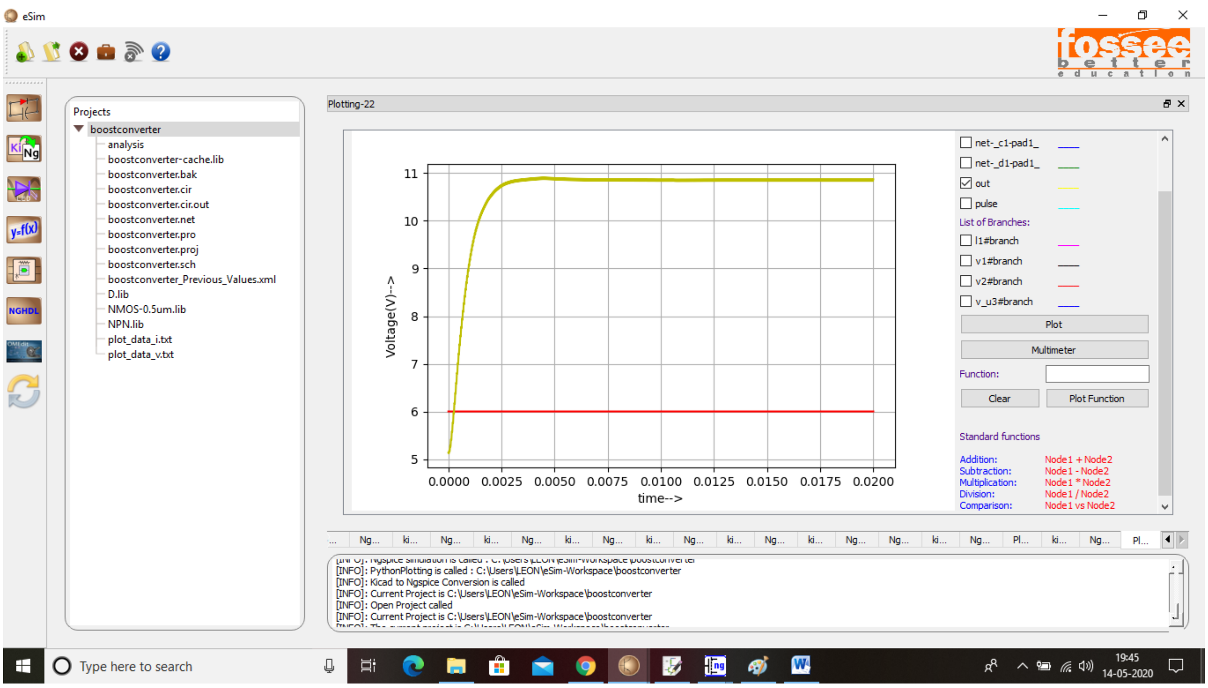

Figure 7: Python plot for input and output voltage waveform

Reference

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