CUK CONVERTER

Circuit Simulation done by

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Theory

The circuit arrangement of the cuk regulator using a power bipolar junction transistor (BJT) is shown in figure 1.Similar to the buck boost regulator, the cuk regulator provides an output voltage that is less than or greater than the input voltage, but the output voltage polarity is opposite to that of the input voltage. It is named after its inventor. When the input voltage is turned on and transistor Q_1 is switched off, diode D_m is forward biased and capacitor C_1 is charged through L_1, D_m and the input supply V_s.

The circuit operation can be divided into two modes. Mode 1 begins when transistor Q_1 is turned on at $t = 0$. The current through inductor L_1 rises. At the same time, the voltage of capacitor C_1 revese biases diode D_m and turns it off. The capacitor C_1 discharges its energy to the circuit formed by C_1, C_2 the load, and L_2. Mode 2 begins when transistor Q_1 is turned off at $t = t_1$. The capacitor C_1 is charged from the input supply and the energy stored in the inductor L_2 is transferred to the load. The diode D_m and transistor Q_1 provide a synchronous switching action. The capacitor C_1 is the medium for transferring energy from the source to the load.The equivalent circuits for the modes are shown in figure 2 and the waveforms for steady state voltages and currents are shown in figure 3 for a continuous load current.

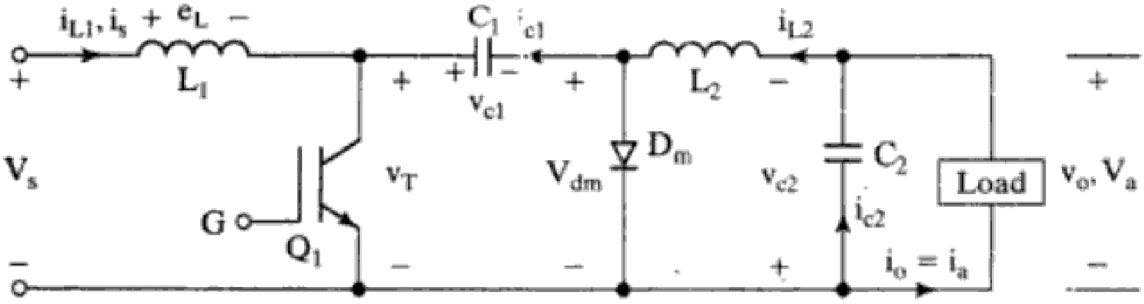

Figure 1 Circuit diagram of cuk converter

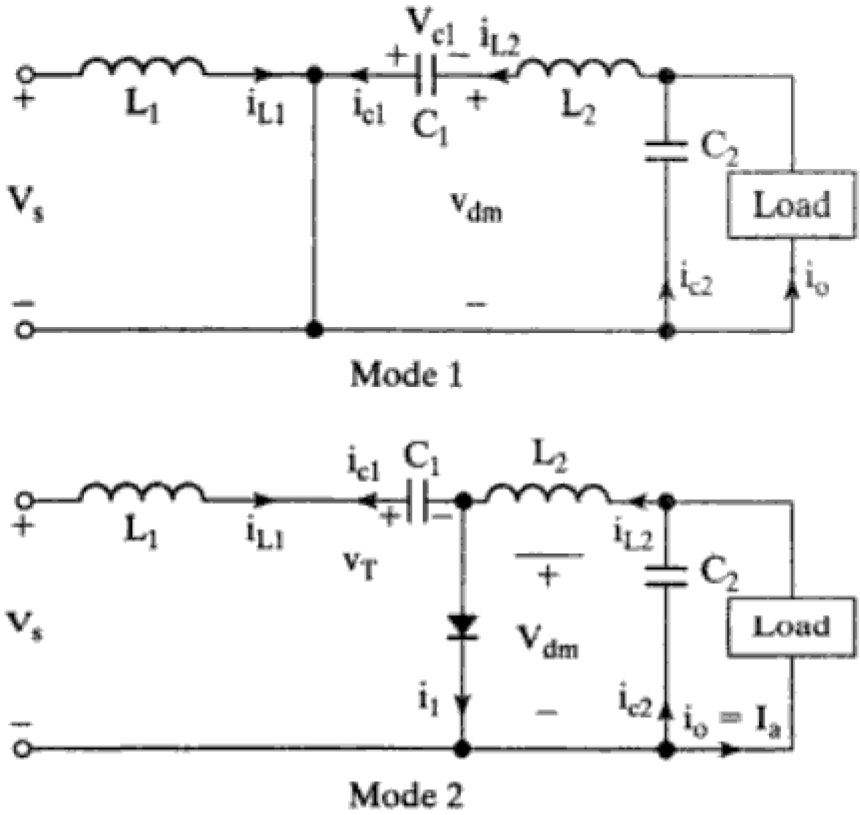

Figure 2 Equivalent circuits

Note:

$$\mathbf{L_1 = 180\mu H, L_2 = 150\mu H, C_1 = 200\mu H, C_2 = 220\mu H, R = 3.2\Omega}$$

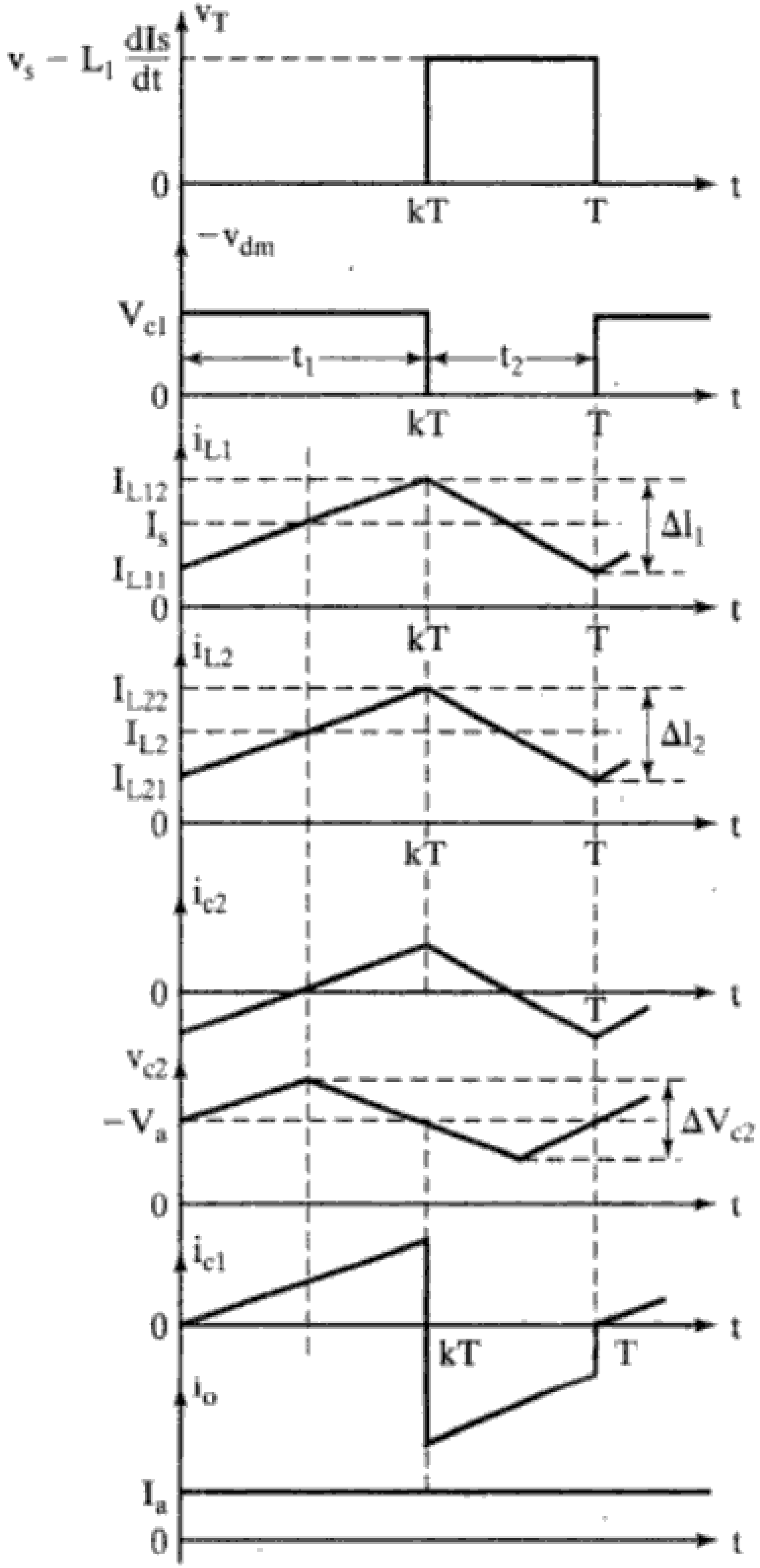

Figure 3 Wave form of cuk converter

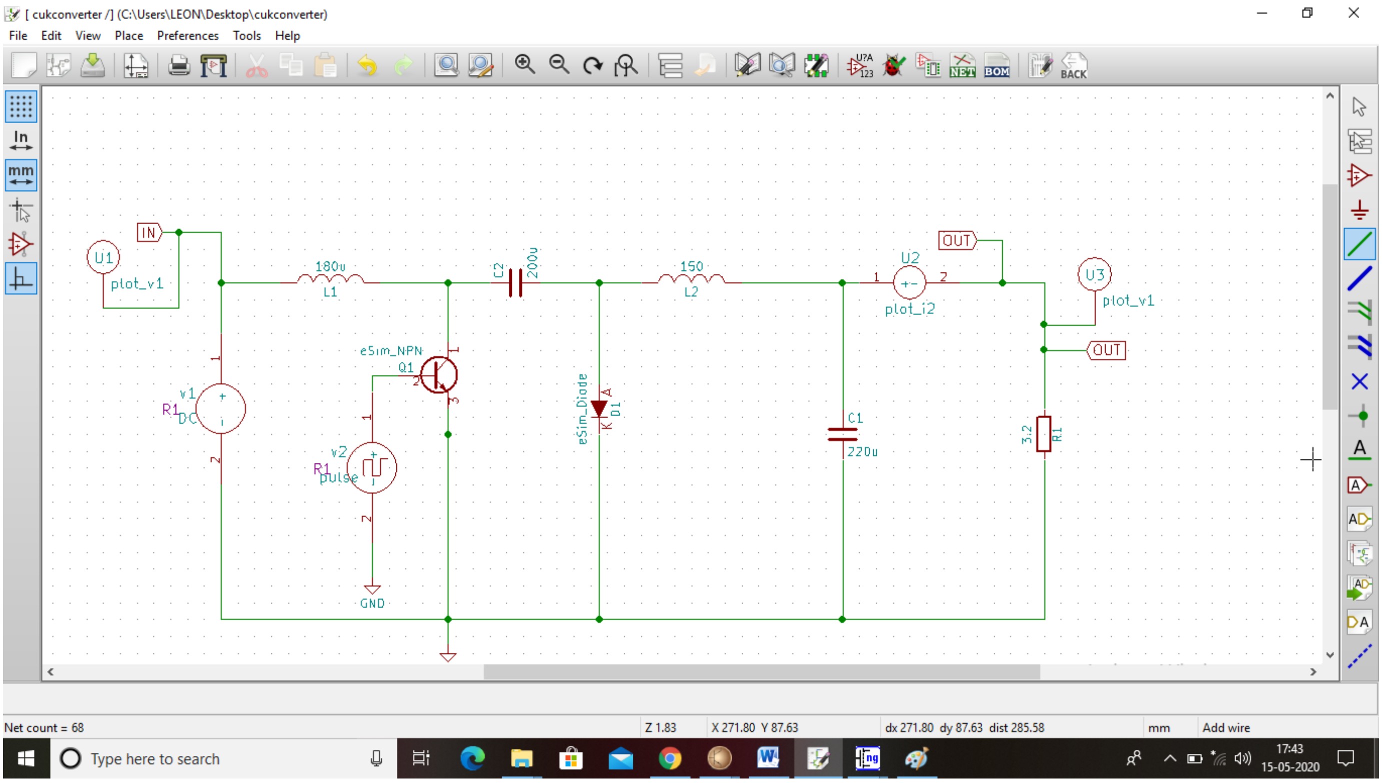

Figure 4: Schematic view of cuk converter in eSim

Simulation results

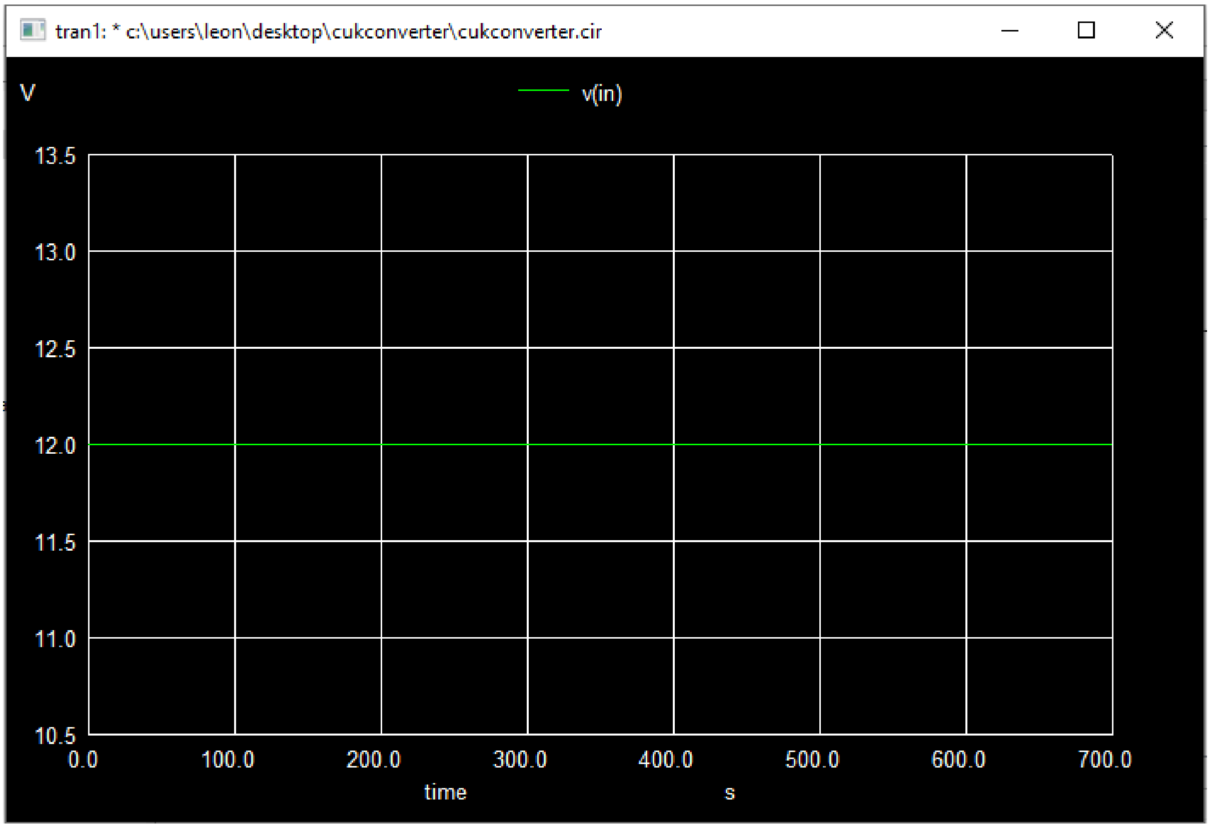

Figure 5: Input voltage wave form

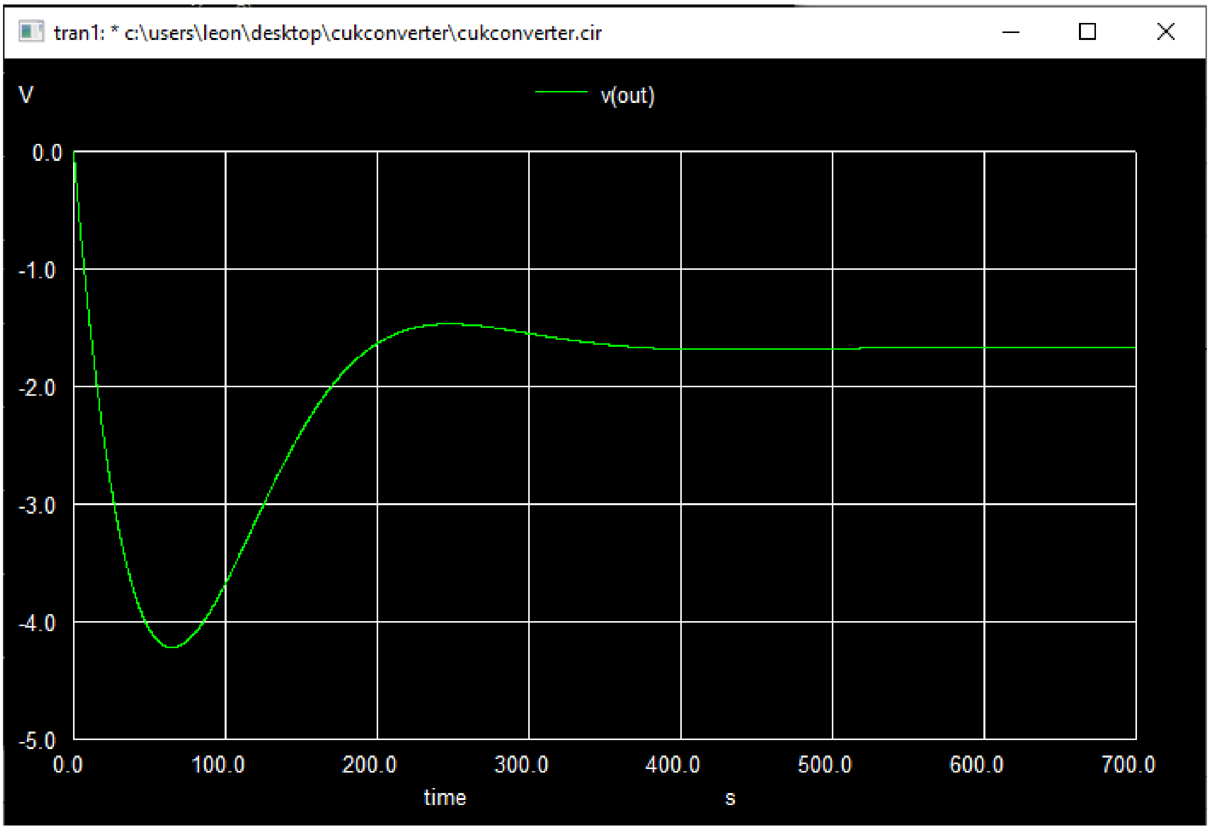

Figure 6: Output voltage wave form

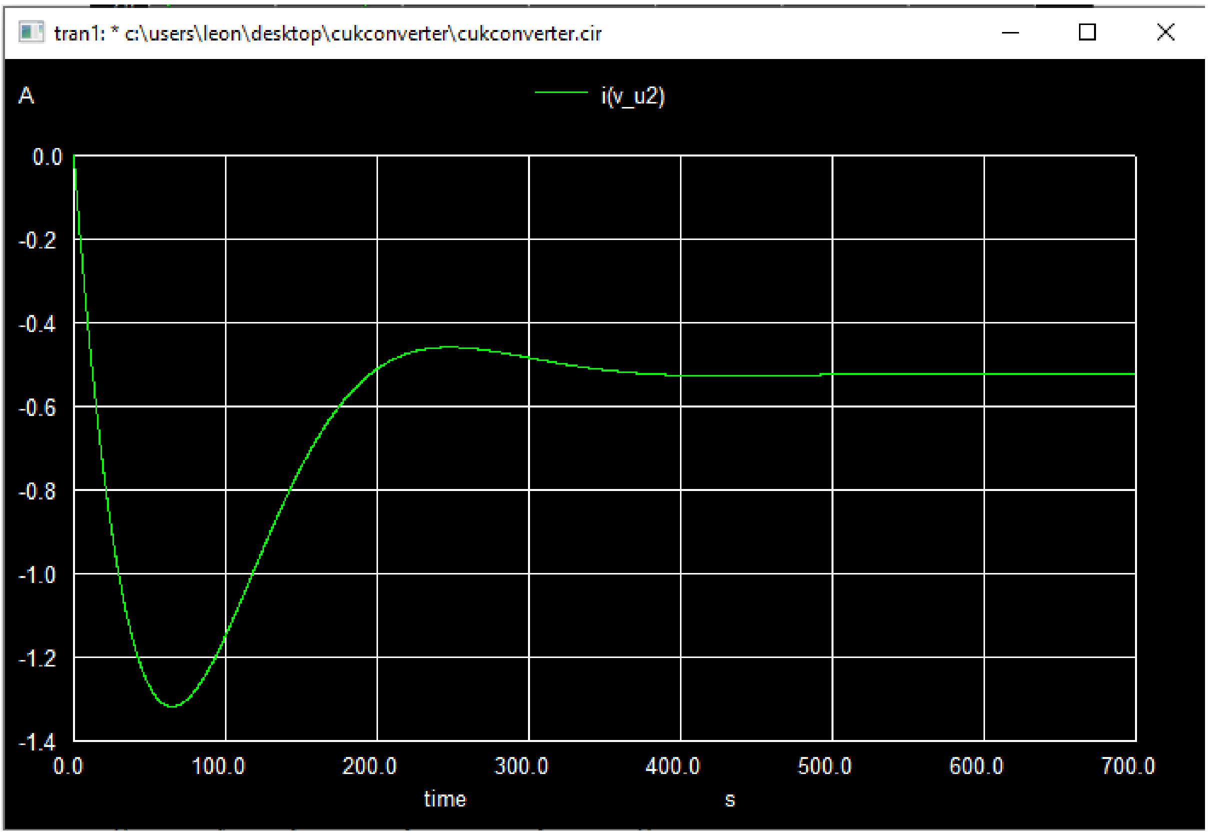

Figure 7: Output Current wave form

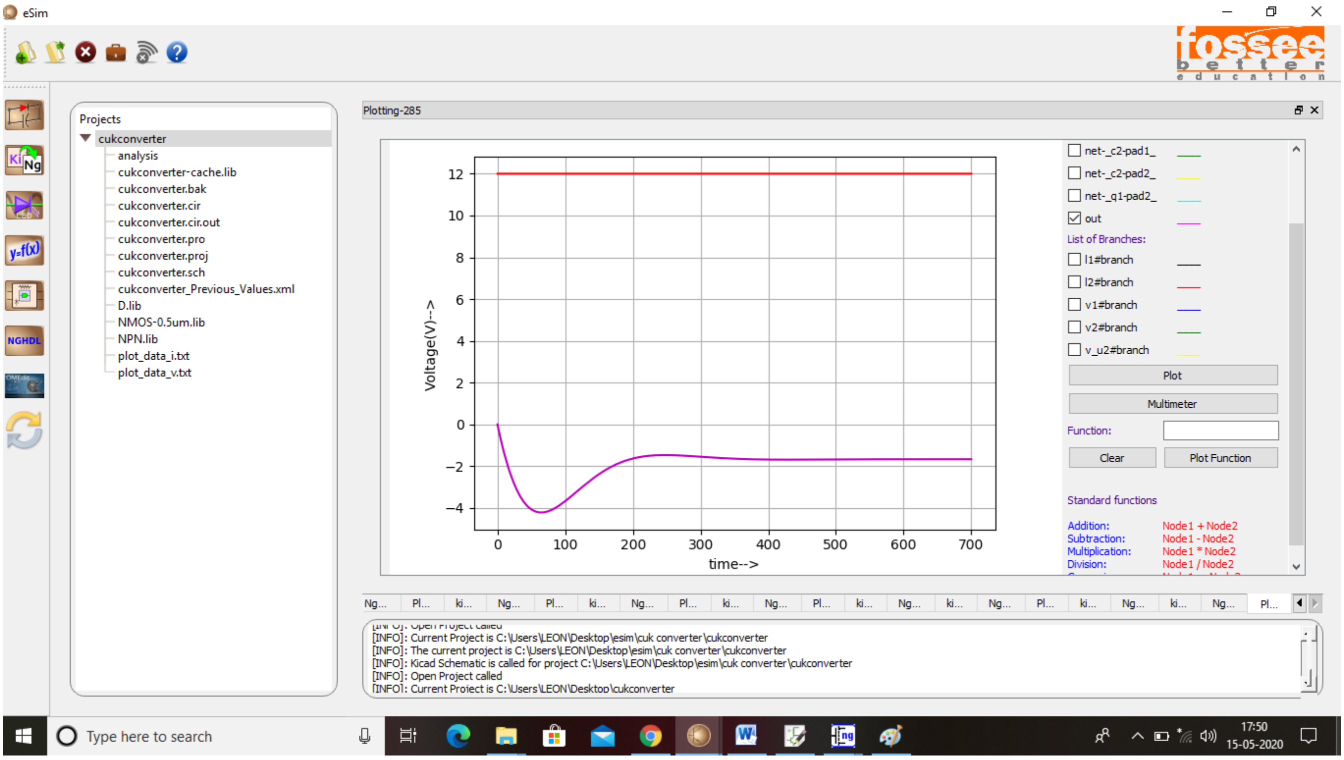

Figure 7: Python plot for input and output voltage waveform

Reference

Power Electronic circuits, Devices and Applications, Muhammed H. Rashid, Third Edition, Pearson Publishers.