Circuit Simulation Project

https://esim.fossee.in/circuit-simulation-project

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Title of the circuit: Single Phase Full Bridge Inverter Using BJT with RLC Load

Theory:

A single-phase full-bridge inverter serves the purpose of converting direct current (DC) into alternating current (AC) by employing pairs of electrical switches. This configuration allows for the generation of alternating half-waves, where S1 and S2 are closed during one half-wave, and S3 and S4 during the other. Figure 1 provides an operational schematic, emphasizing the complementary operation of switches S1&S2 and S3&S4. These switches are optimized for efficient operation. Modulation involves utilizing identical reference voltages of opposite polarity. Typically, the same electrical carrier is utilized for both driving signals. With the inclusion of an RLC load, the inverter transforms the DC input voltage into AC output voltage effectively.

- **DC Input Voltage**: The DC input voltage is applied to the input of the inverter circuit.
- **Full-Bridge Inverter:** The Full Bridge inverter with RLC Load, typically made using 4 BJT Switches and 4 Diodes.

Mode-1: - When two switch that is S1&S2 are conducts the load voltage is positive and load current flows from source to load. Here S3&S4 is turned-off.

Mode-2: - In this mode, other two switch that is S3&S4 are conducts the load voltage is negative and load current flows from source to load. Here S1&S2 is turned-off.

As the load is RLC so inductor deflux the current through antiparallel diode. Therefore diodes are effective in this circuit.

- **AC output Voltage:** After this working of switches the we get the desired DC output waveform.

1. Schematic Diagram :

The circuit schematic of Single-Phase Full Bridge Inverter with RLC load in eSim is as shown below:

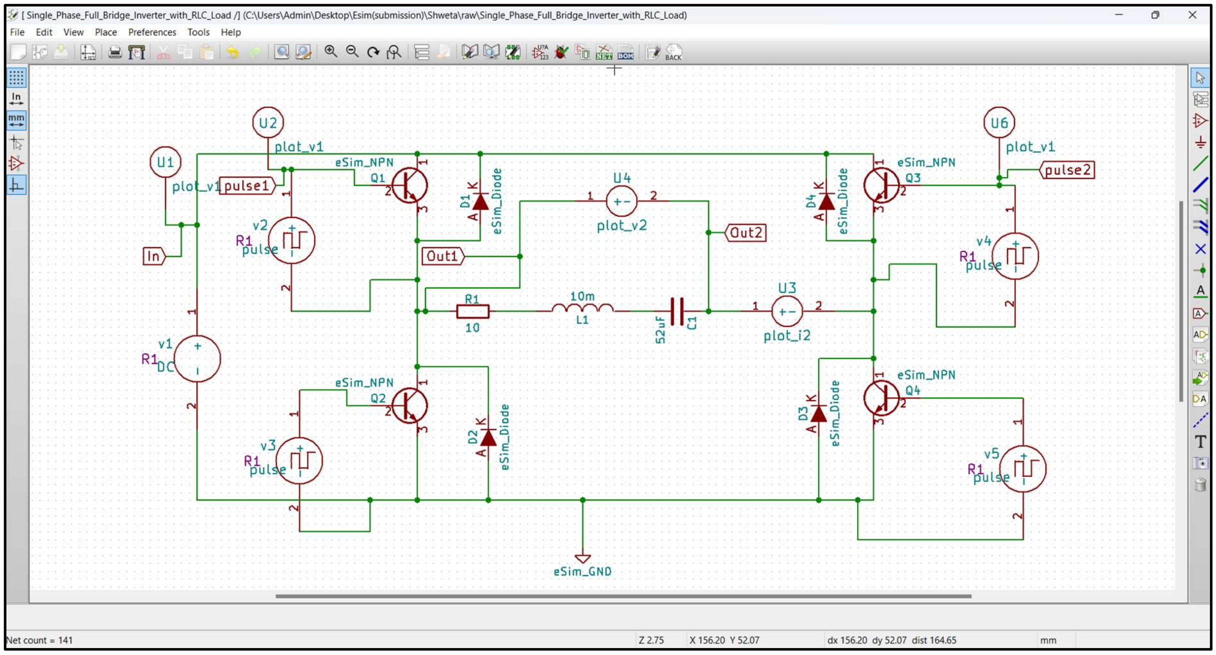


Figure 1: Circuit schematic of Single-Phase Full Bridge Inverter with RLC load

2. Transient Analysis Parameters are as below :

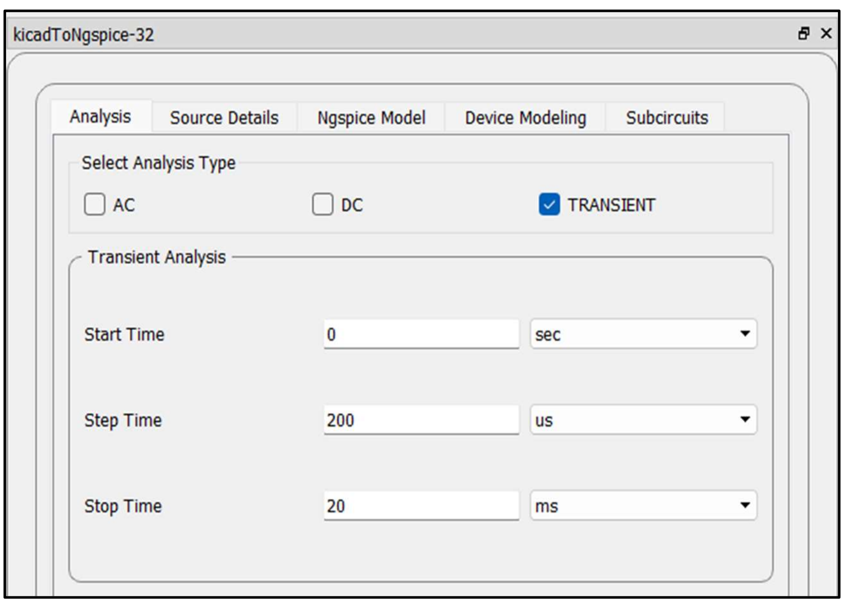


Figure 3 : Transient Analysis (Start,Step & Stop time)

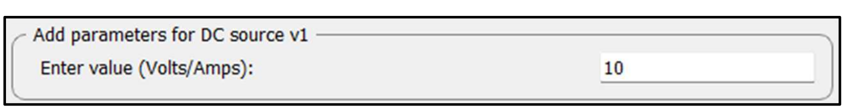
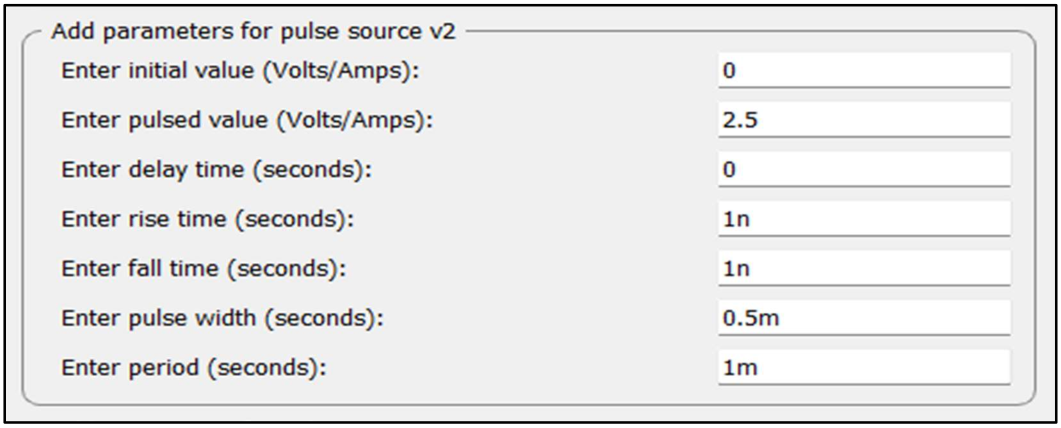


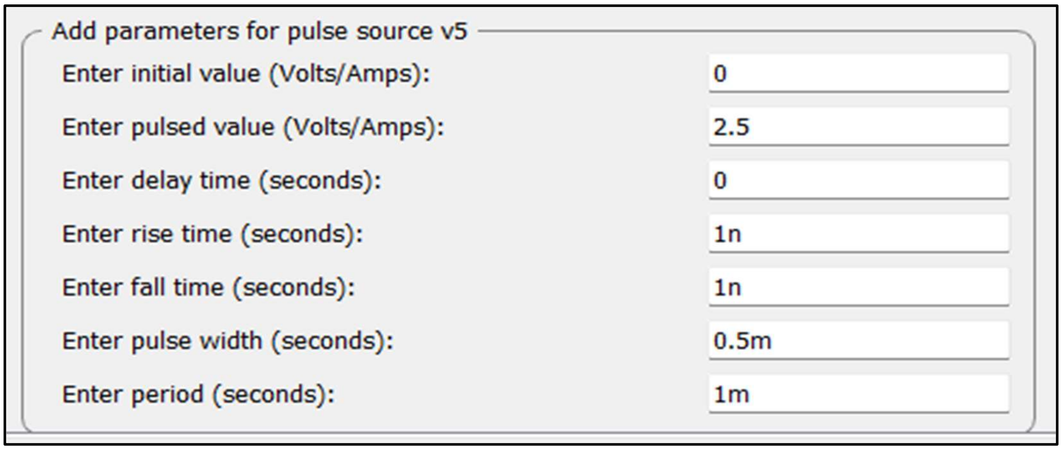
Figure 2: DC Source V1



Add parameters for pulse source v2

Enter initial value (Volts/Amps):	0
Enter pulsed value (Volts/Amps):	2.5
Enter delay time (seconds):	0
Enter rise time (seconds):	1n
Enter fall time (seconds):	1n
Enter pulse width (seconds):	0.5m
Enter period (seconds):	1m

Figure 4: Parameters for Pulse Source v2



Add parameters for pulse source v5

Enter initial value (Volts/Amps):	0
Enter pulsed value (Volts/Amps):	2.5
Enter delay time (seconds):	0
Enter rise time (seconds):	1n
Enter fall time (seconds):	1n
Enter pulse width (seconds):	0.5m
Enter period (seconds):	1m

Figure 5: Parameters for Pulse Source v5

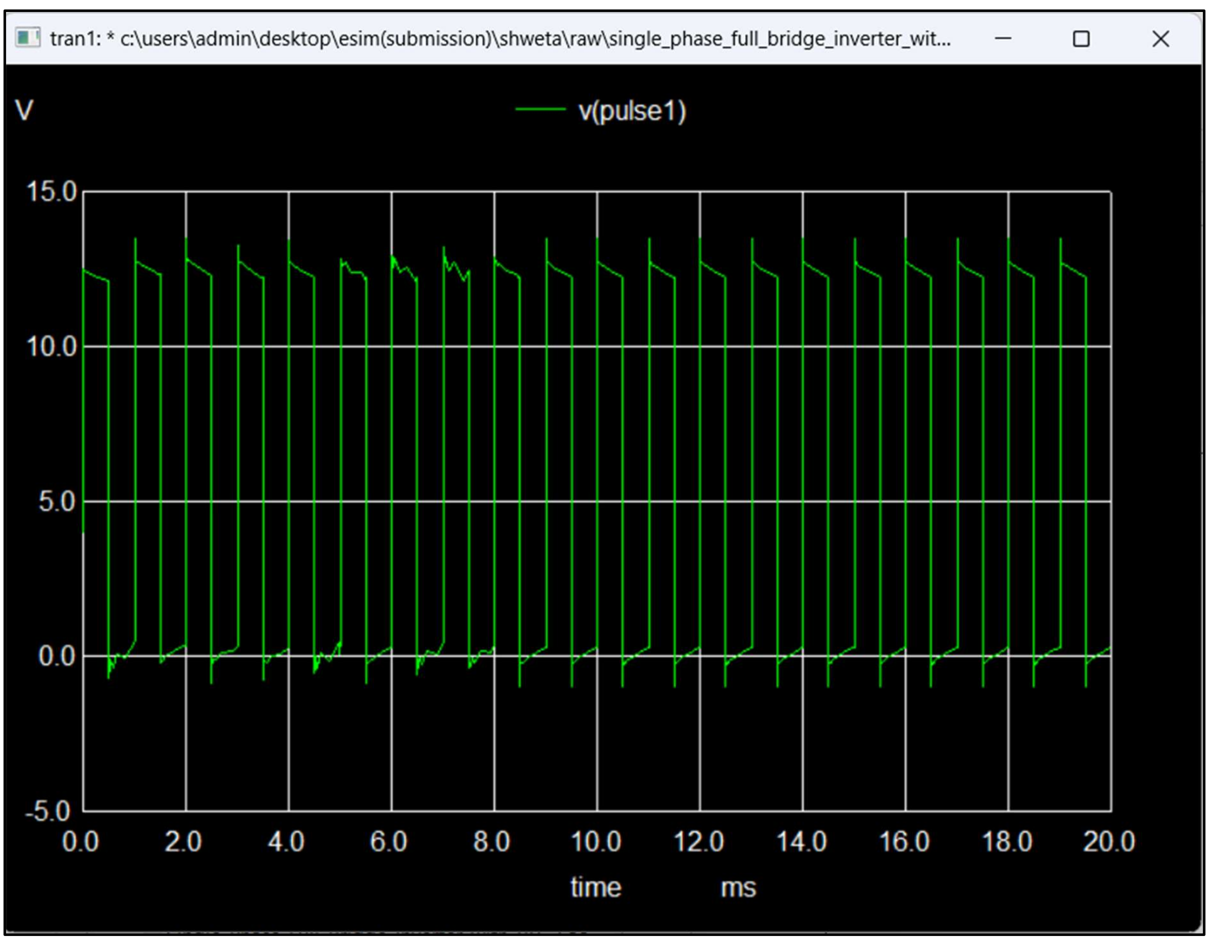
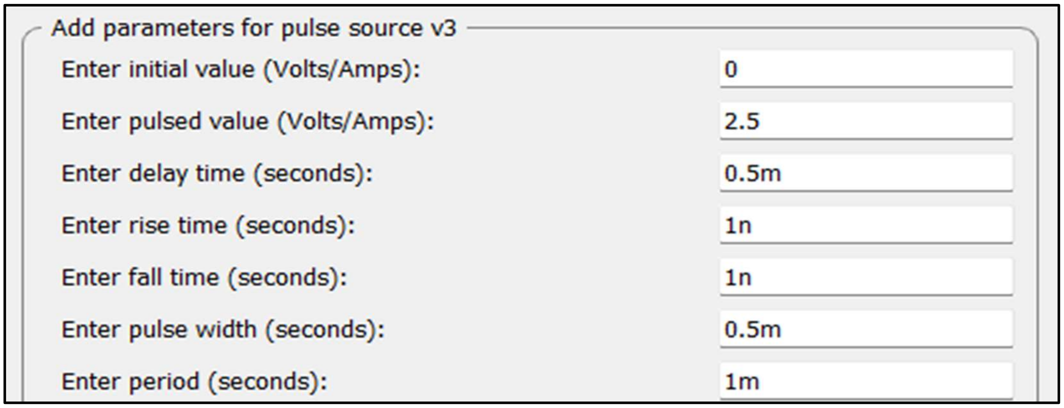


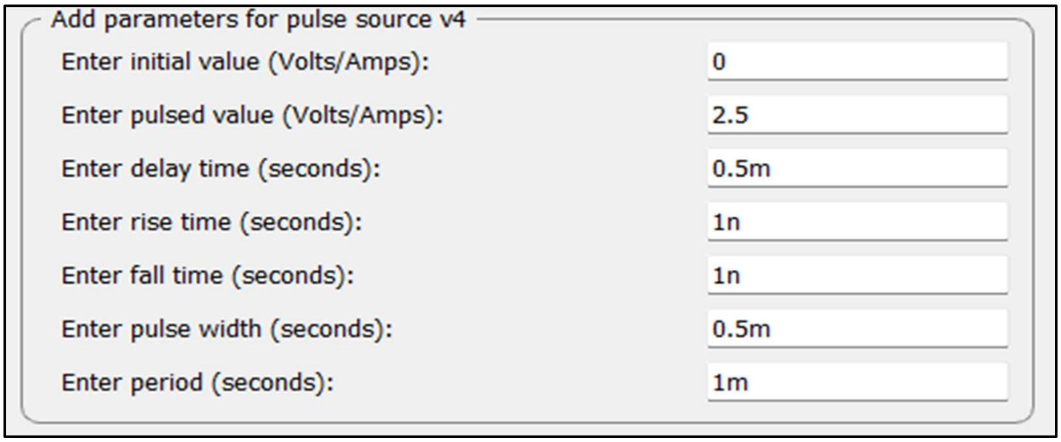
Figure 6: Ngspice Plot for Pulse 1



Add parameters for pulse source v3

Enter initial value (Volts/Amps):	0
Enter pulsed value (Volts/Amps):	2.5
Enter delay time (seconds):	0.5m
Enter rise time (seconds):	1n
Enter fall time (seconds):	1n
Enter pulse width (seconds):	0.5m
Enter period (seconds):	1m

Figure 7: Parameters for Pulse Source v3



Add parameters for pulse source v4

Enter initial value (Volts/Amps):	0
Enter pulsed value (Volts/Amps):	2.5
Enter delay time (seconds):	0.5m
Enter rise time (seconds):	1n
Enter fall time (seconds):	1n
Enter pulse width (seconds):	0.5m
Enter period (seconds):	1m

Figure 8: Parameters for Pulse Source v4

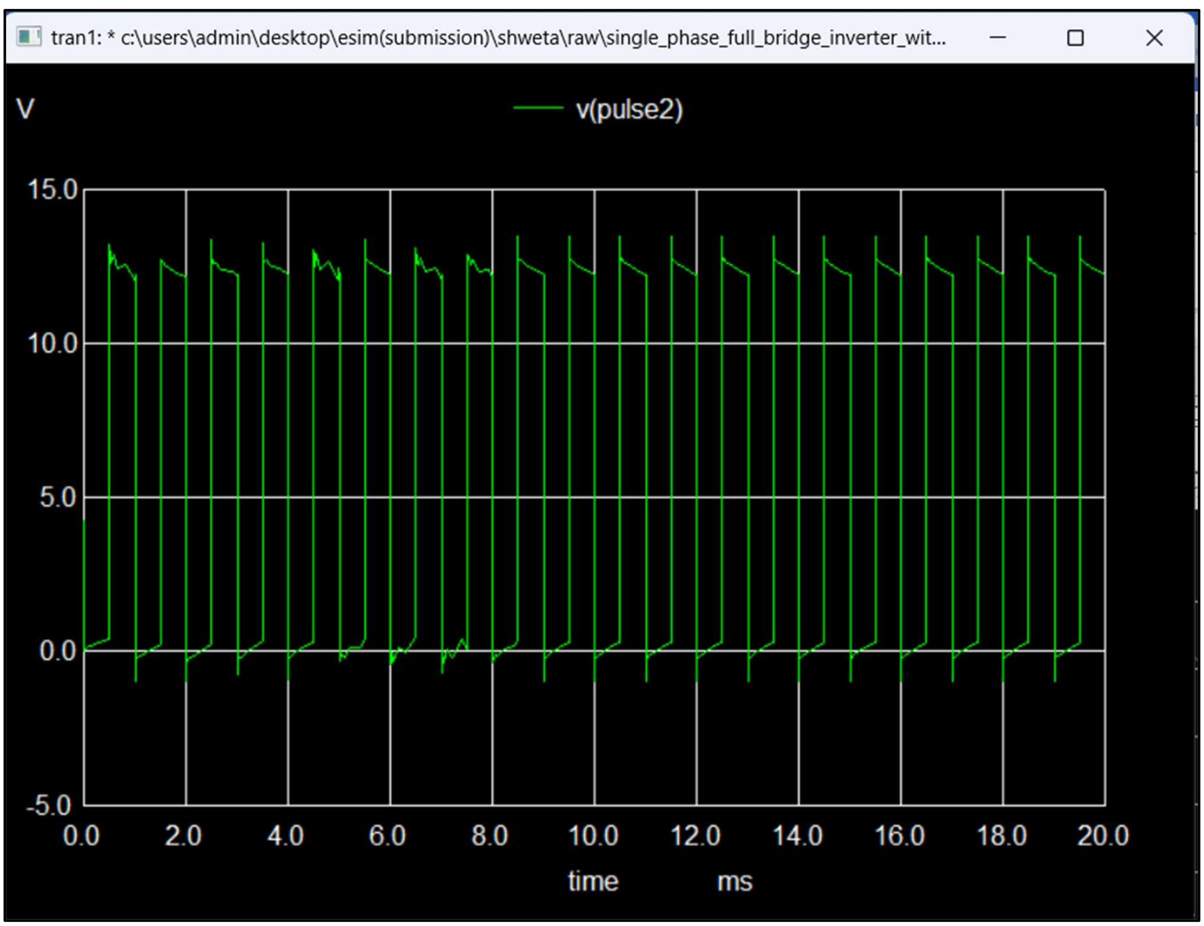


Figure 9: Ngspice Plot for Pulse 2

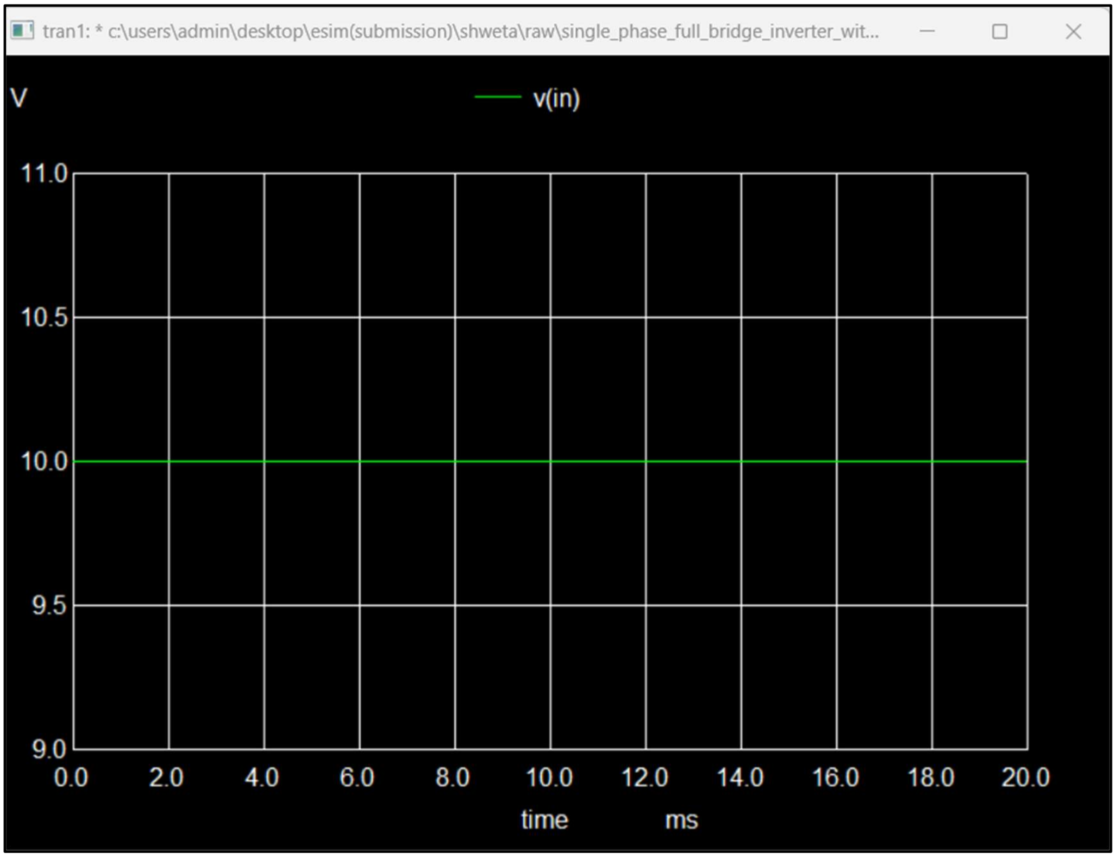


Figure 11: Ngspice Input Voltage Plot

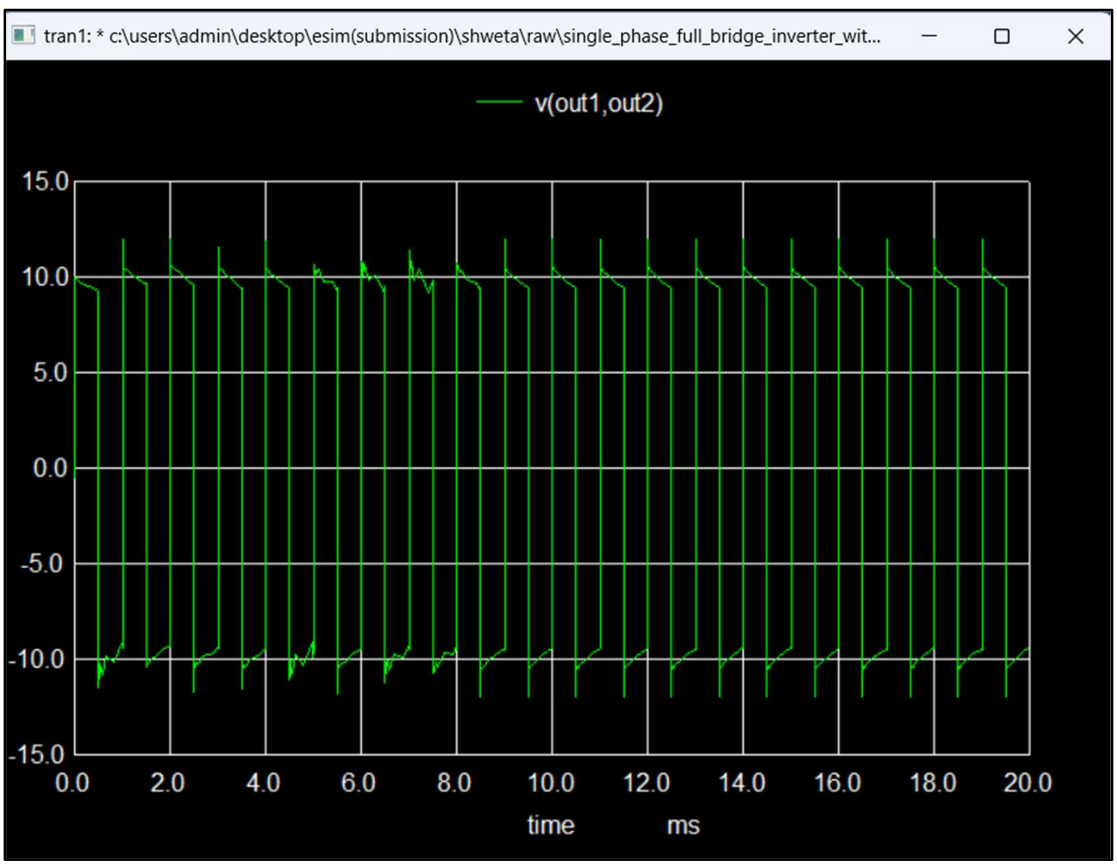


Figure 10: Ngspice Output Voltage Plot

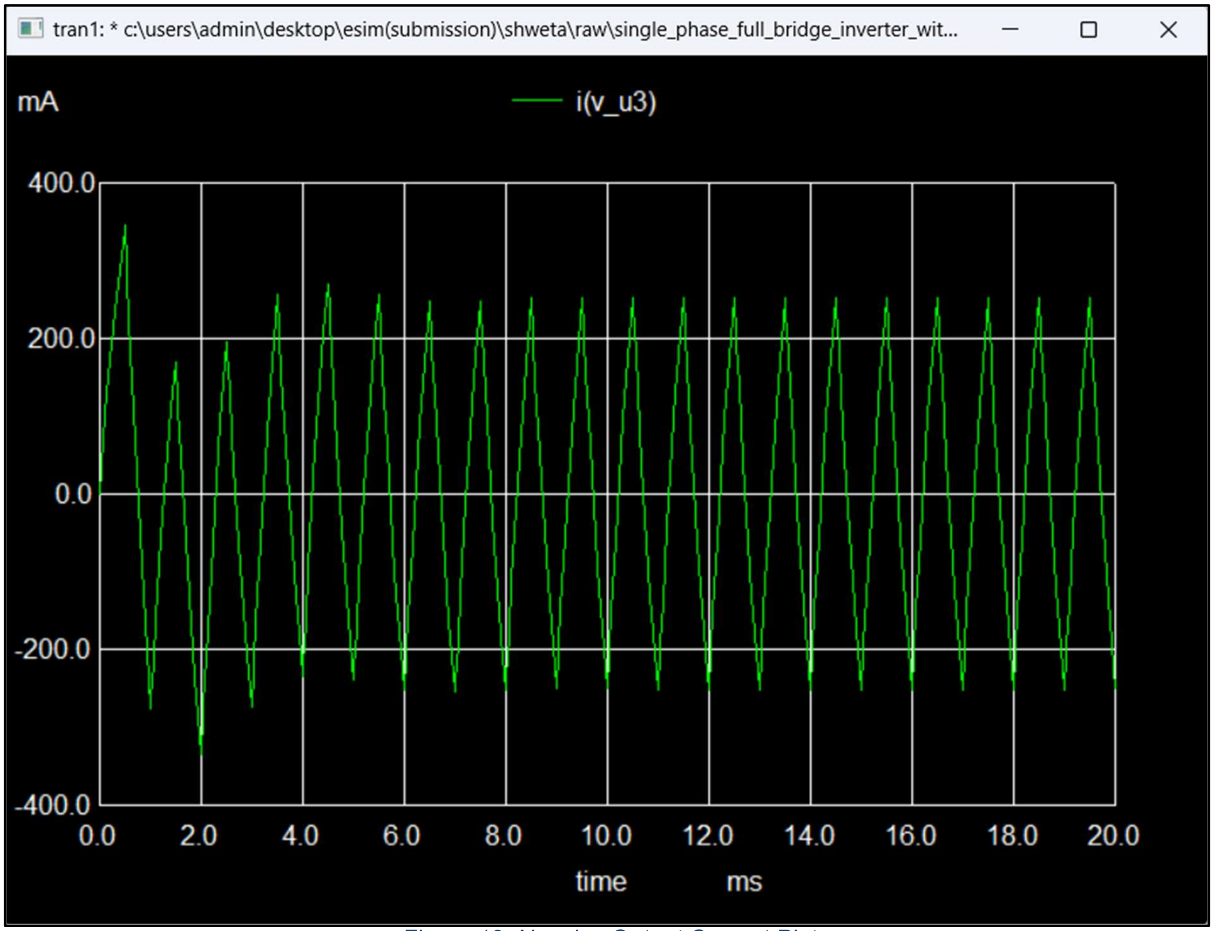


Figure 12: Ngspice Output Current Plot

- Following Libraries are included:

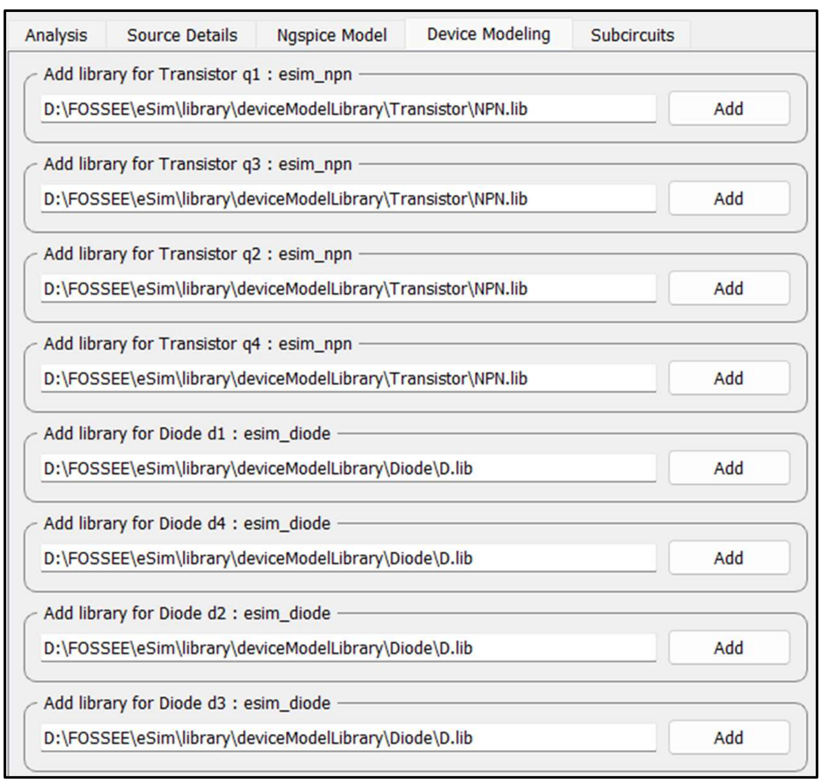


Figure 13 : Device Modeling

2. Python Plot:

- Input Voltage:

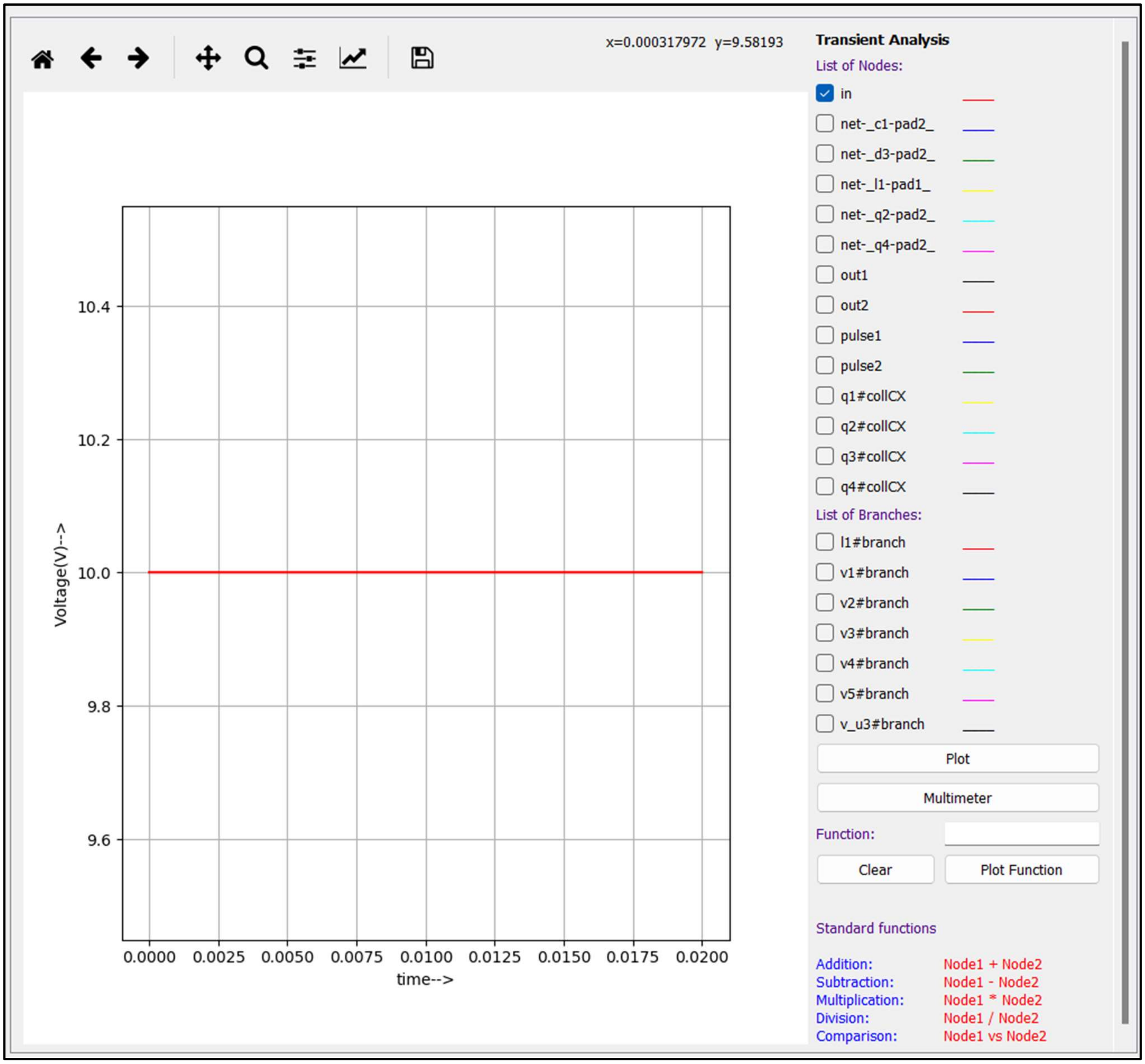


Figure 14 : Python Plot of Input Voltage

- Output Voltage:

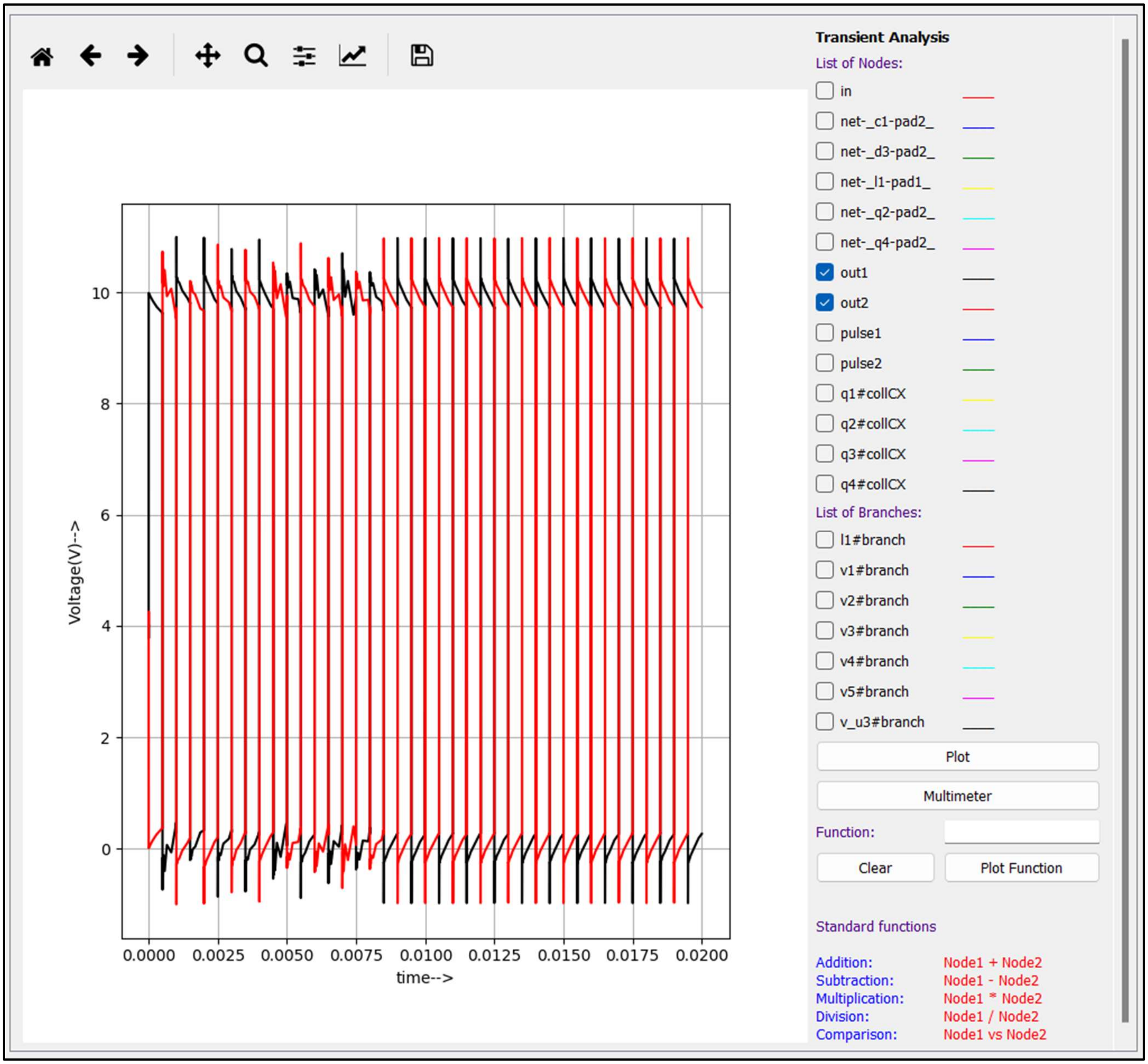


Figure 15 : Python Plot of Output Voltage

Conclusion: The single-phase full-bridge inverter with BJT switches converts DC to AC by alternately activating S1&S2 and S3&S4, generating positive and negative load voltages respectively. The RLC load facilitates smooth current flow, complemented by antiparallel diodes, resulting in efficient DC-to-AC conversion for diverse power electronics applications.

References: Power Electronics (M D Singh & K B Khanchandani) 2nd Edition (Page No. 545)