Variable nine pulse AC converter

Circuit simulation done by

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Theory/Description:

In this project, three nine waves are generated using the nine-phase sine wave generator. A nine-phase sine wave generator typically involves using three sets of three-phase sine wave generators, each set being phase-shifted by 120 degrees. This approach allows for the generation of nine sine waves with different phases. transistor stages configured in a cross coupled manner, having equivalent RC timing constants across their bases.

Circuit explanation:

- **JFETs (Junction Field-Effect Transistors) are three-terminal semiconductor devices that can be used for various analog circuit applications, including amplification and switching. In a JFET, the gate-to-source voltage controls the flow of current between the drain and source terminals.**

- **The JFETs could be configured in various amplifier topologies, such as common source, common drain, or common gate configurations. These configurations determine the input-output characteristics and gain of the amplifier.**
- **The above mutual push and pull procedure induces and settles into a continuous sequential train of conduction across the transistors causing the intended three phase signal pattern to appear across the collectors of the transistors. Owing the gradual charge and discharge pattern of the capacitors, the resultant signal shape is a pure sine wave .**

eSim circuit diagram:

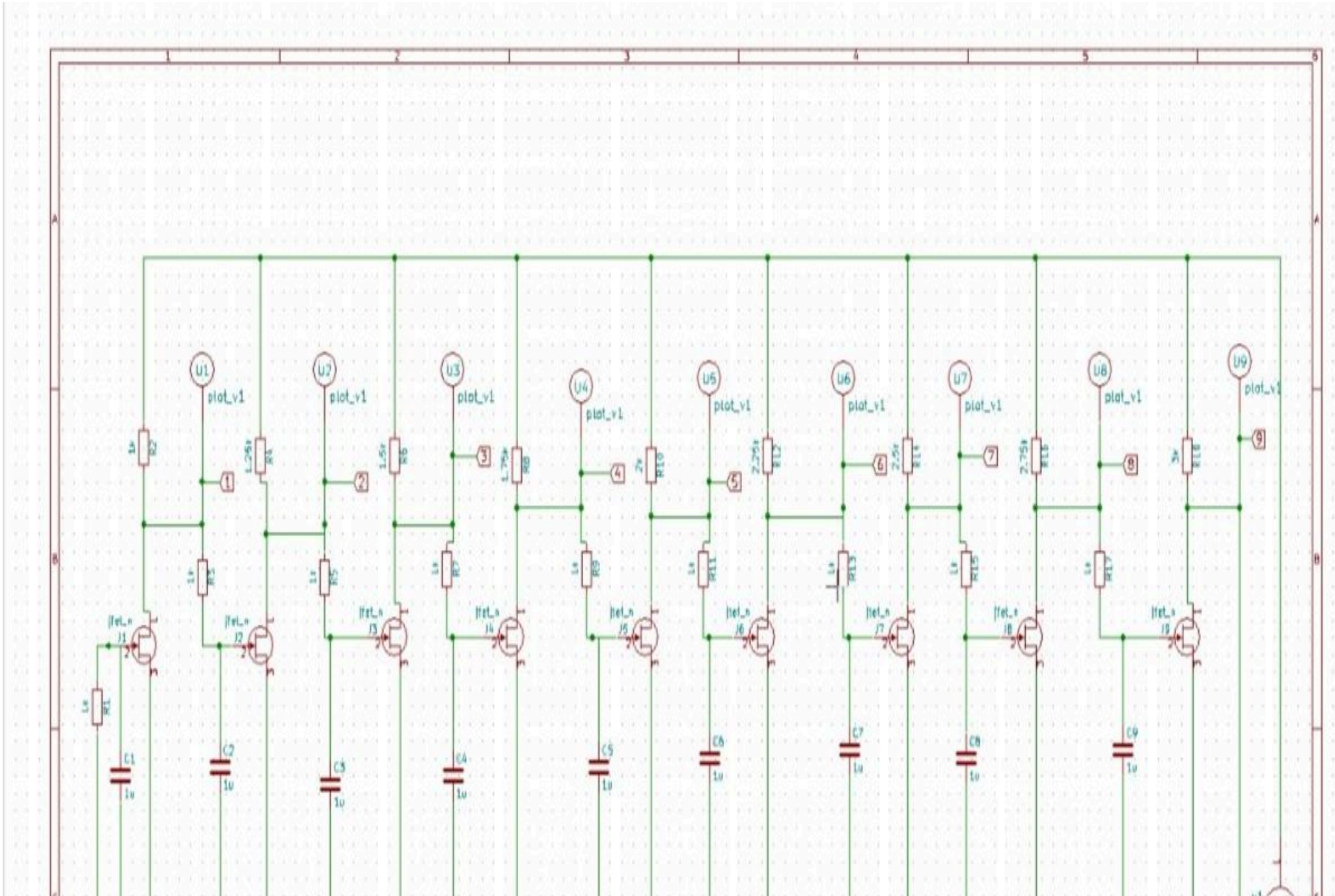
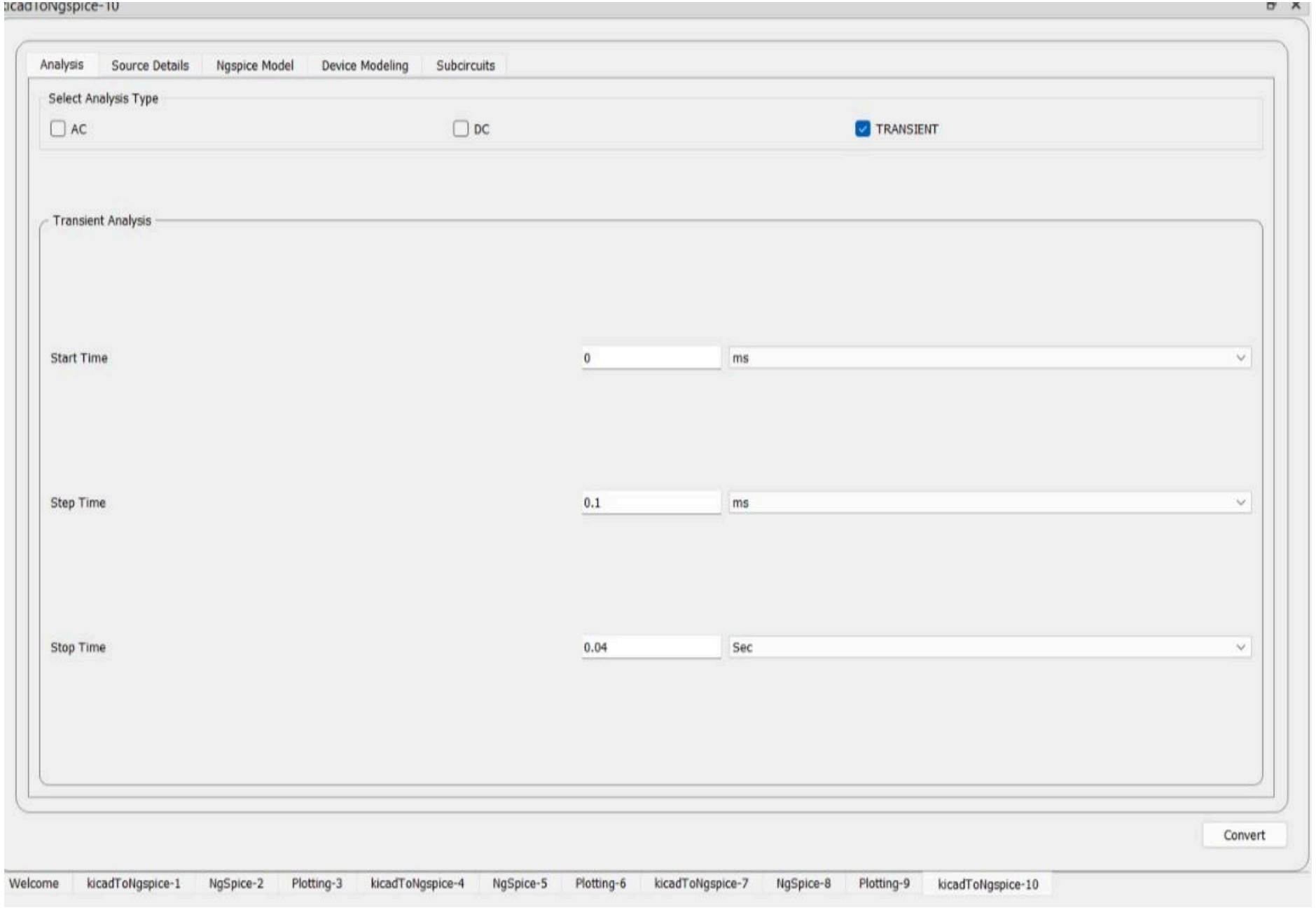

U1
plot_v1
U2
plot_v1
U3
plot_v1
U4
plot_v1
U5
plot_v1
U6
plot_v1
U7
plot_v1
U8
plot_v1
U9
plot_v1
1k
R2
1.25k
R4
1.5k
R6
1.75k
R8
2k
R10
2.25k
R12
2.5k
R14
2.75k
R16
3k
R18
1k
R1
1k
R3
1k
R5
1k
R7
1k
R9
1k
R11
1k
R13
1k
R15
1k
R17
1
2
3
4
5
6
7
8
9
jfet_n
J1
jfet_n
J2
jfet_n
J3
jfet_n
J4
jfet_n
J5
jfet_n
J6
jfet_n
J7
jfet_n
J8
jfet_n
J9
C1
1u
C2
1u
C3
1u
C4
1u
C5
1u
C6
1u
C7
1u
C8
1u
C9
1u

Fig: eSim circuit diagram (switch on condition)

Simulation Results:


icadToNgspice-10
Analysis
Source Details
Ngspice Model
Device Modeling
Subcircuits
Select Analysis Type
AC
DC
TRANSIENT
Transient Analysis
Start Time
0
ms
Step Time
0.1
ms
Stop Time
0.04
Sec
Convert
Welcome
kicadToNgspice-1
NgSpice-2
Plotting-3
kicadToNgspice-4
NgSpice-5
Plotting-6
kicadToNgspice-7
NgSpice-8
Plotting-9
kicadToNgspice-10

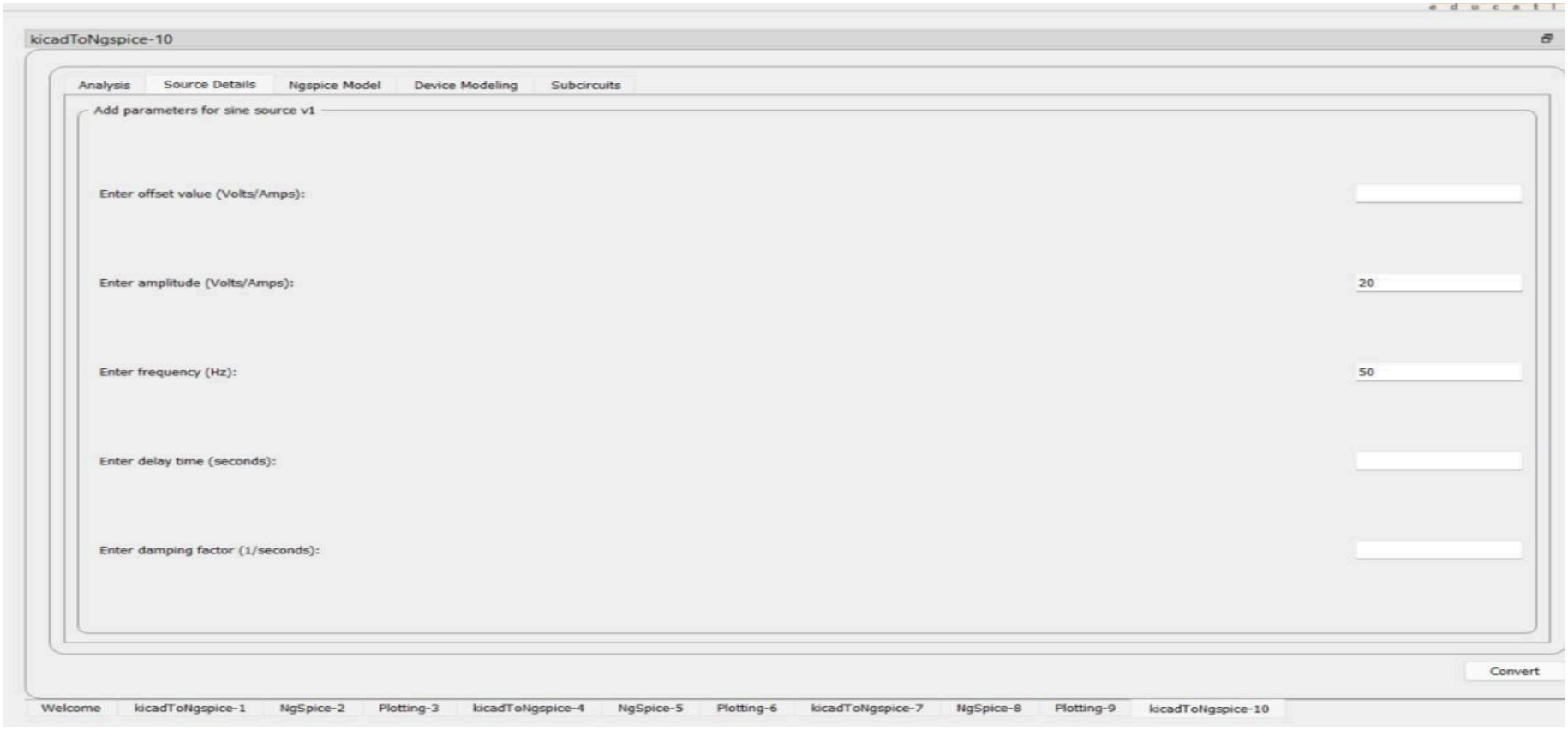


Fig:Kicad to NgSpice

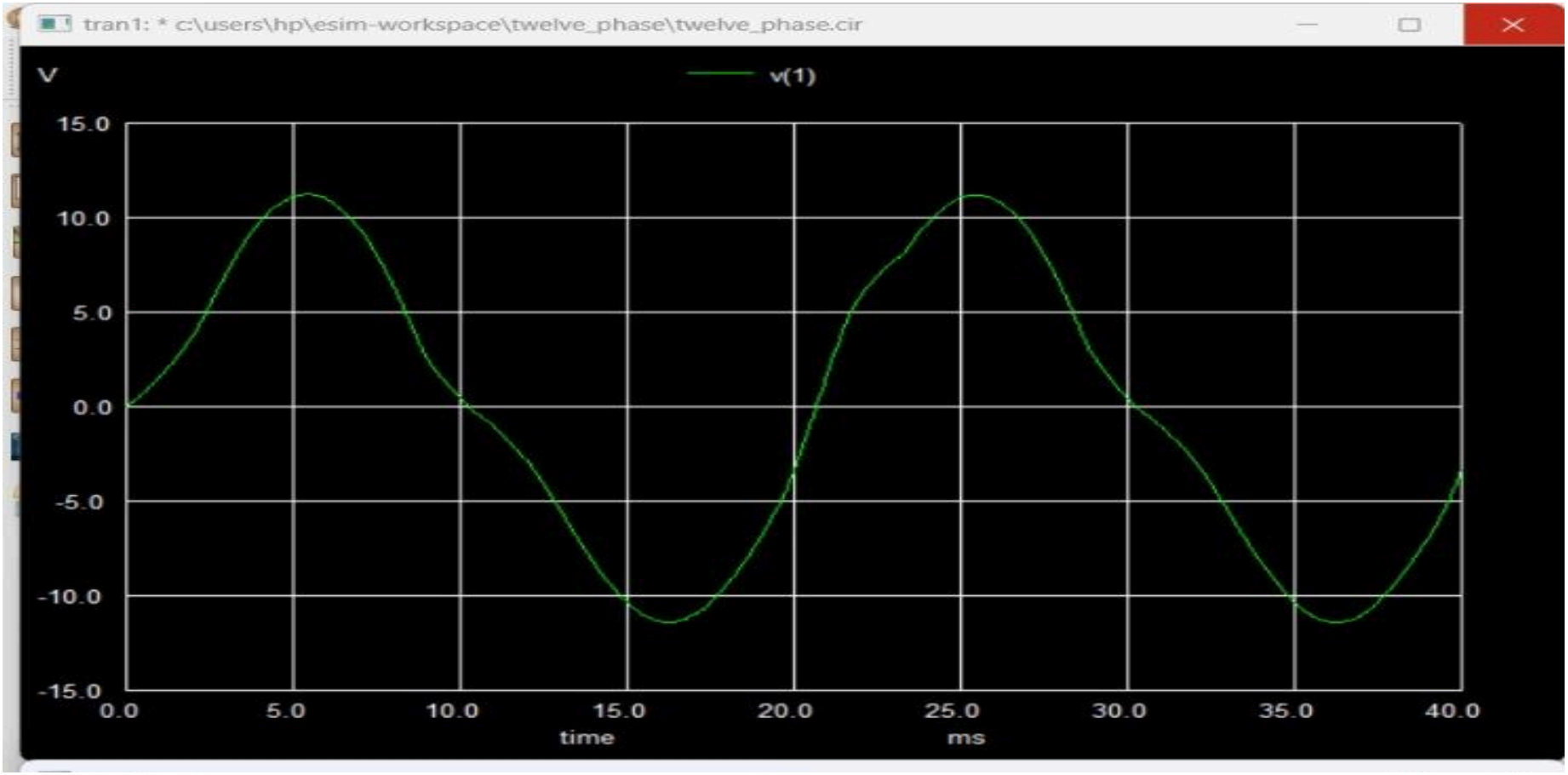


Figure : Ngspice output Sine Wave 1

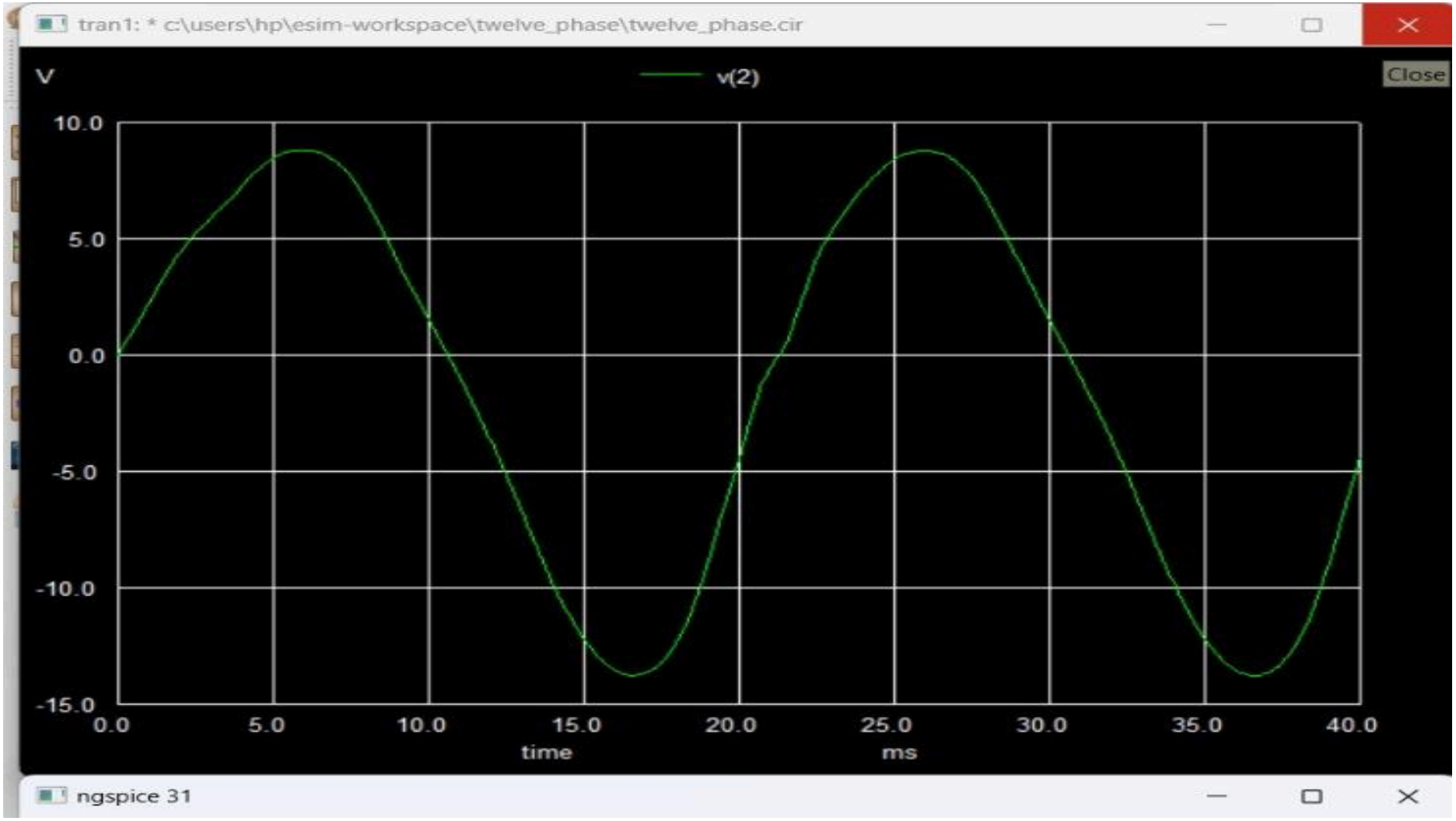


Figure : Ngspice output Sine Wave 2

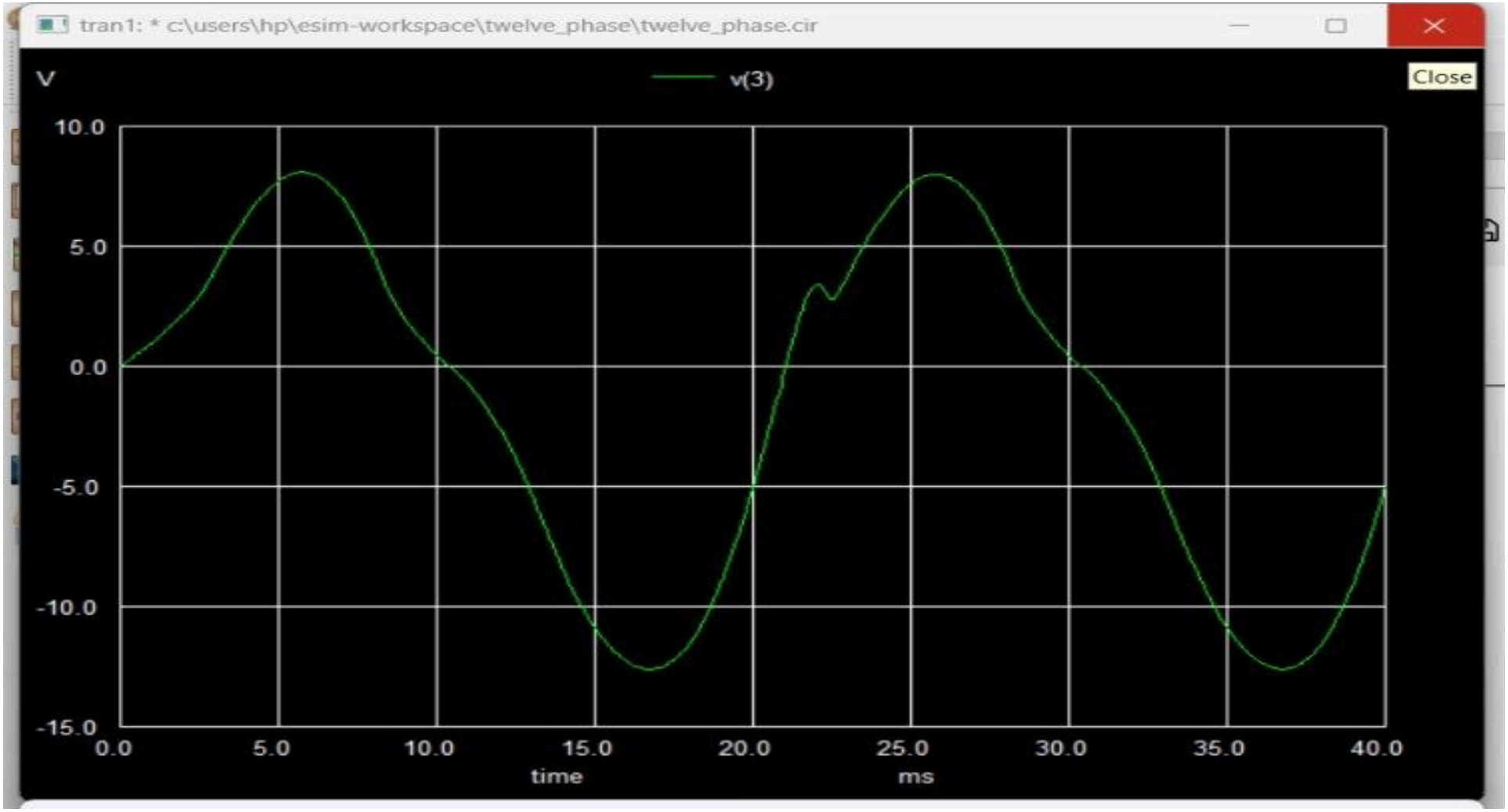


Figure : Ngspice output Sine Wave 3

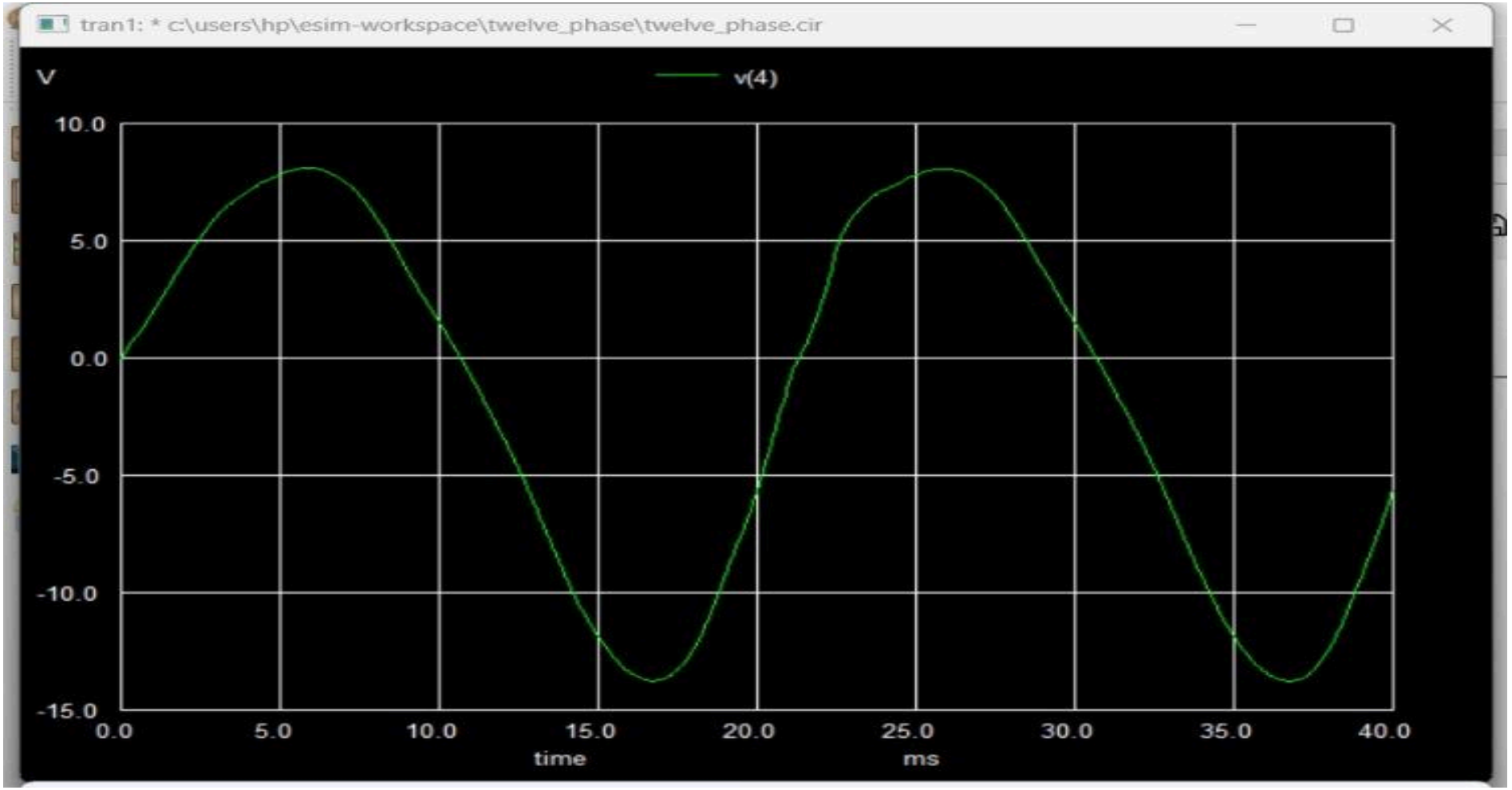


Figure : Ngspice output Sine Wave 4

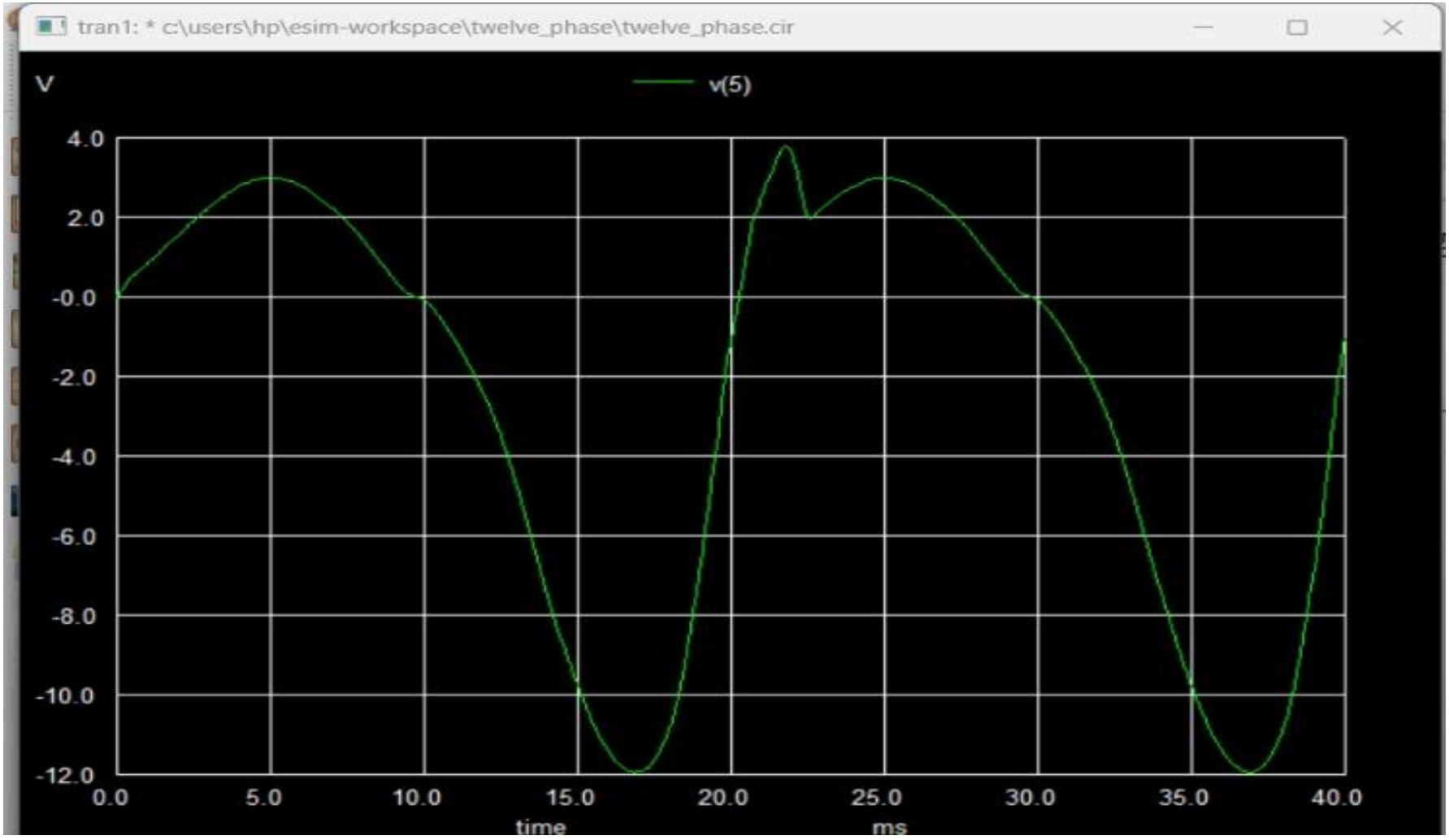


Figure : Ngspice output Sine Wave 5

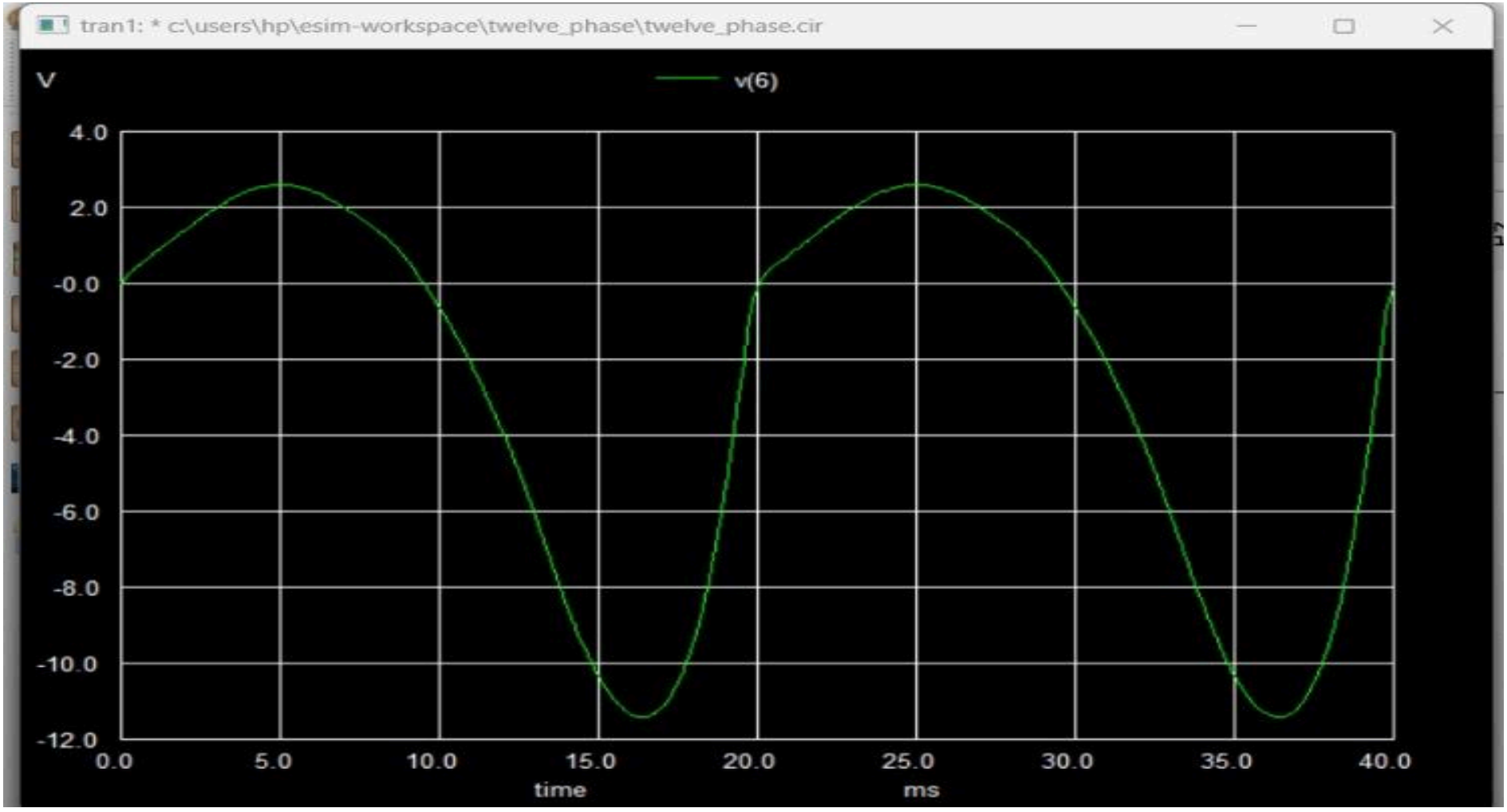


Figure : Ngspice output Sine Wave 6

Figure : Ngspice output Sine Wave 7

Figure : Ngspice output Sine Wave 8

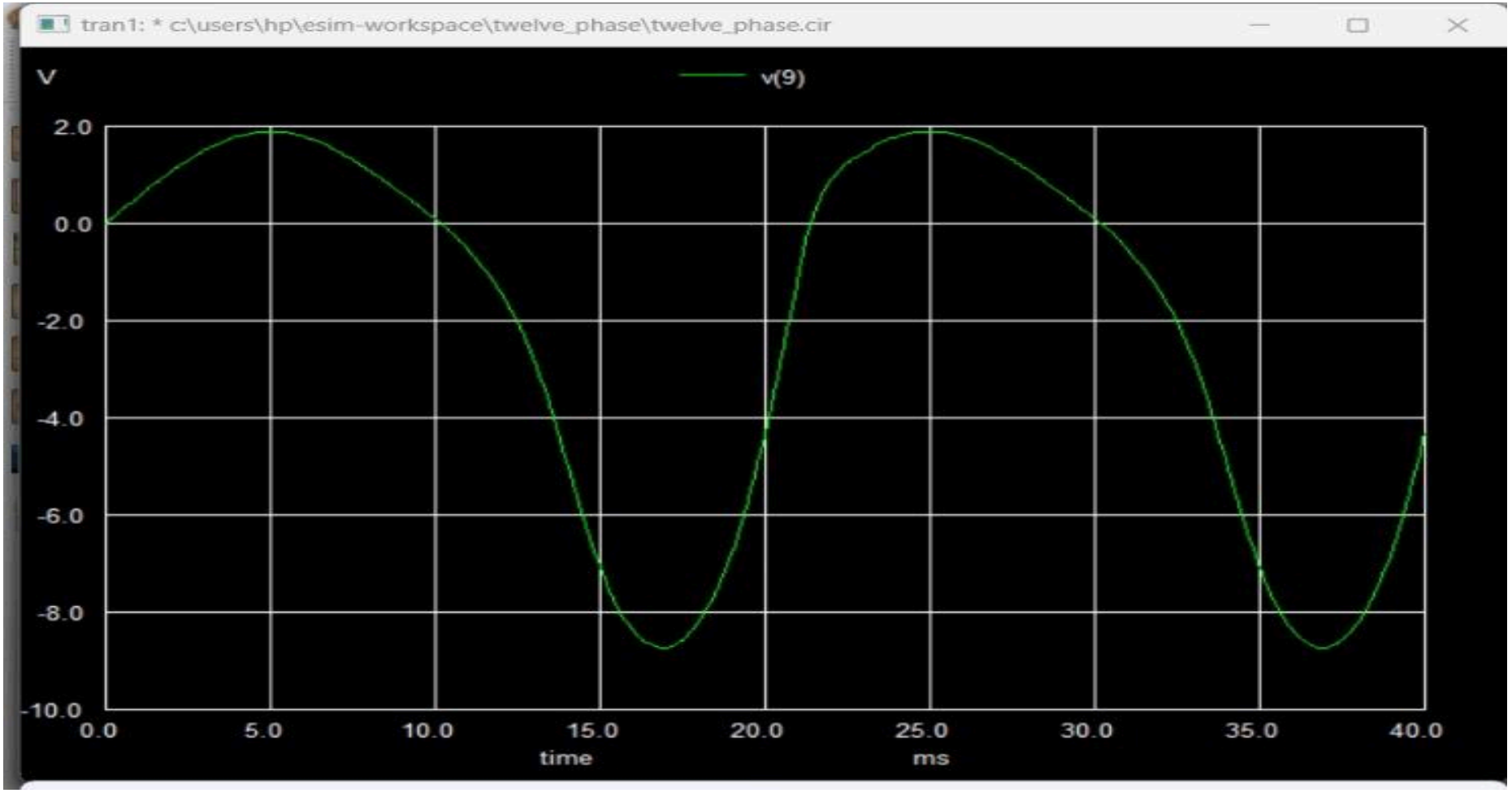
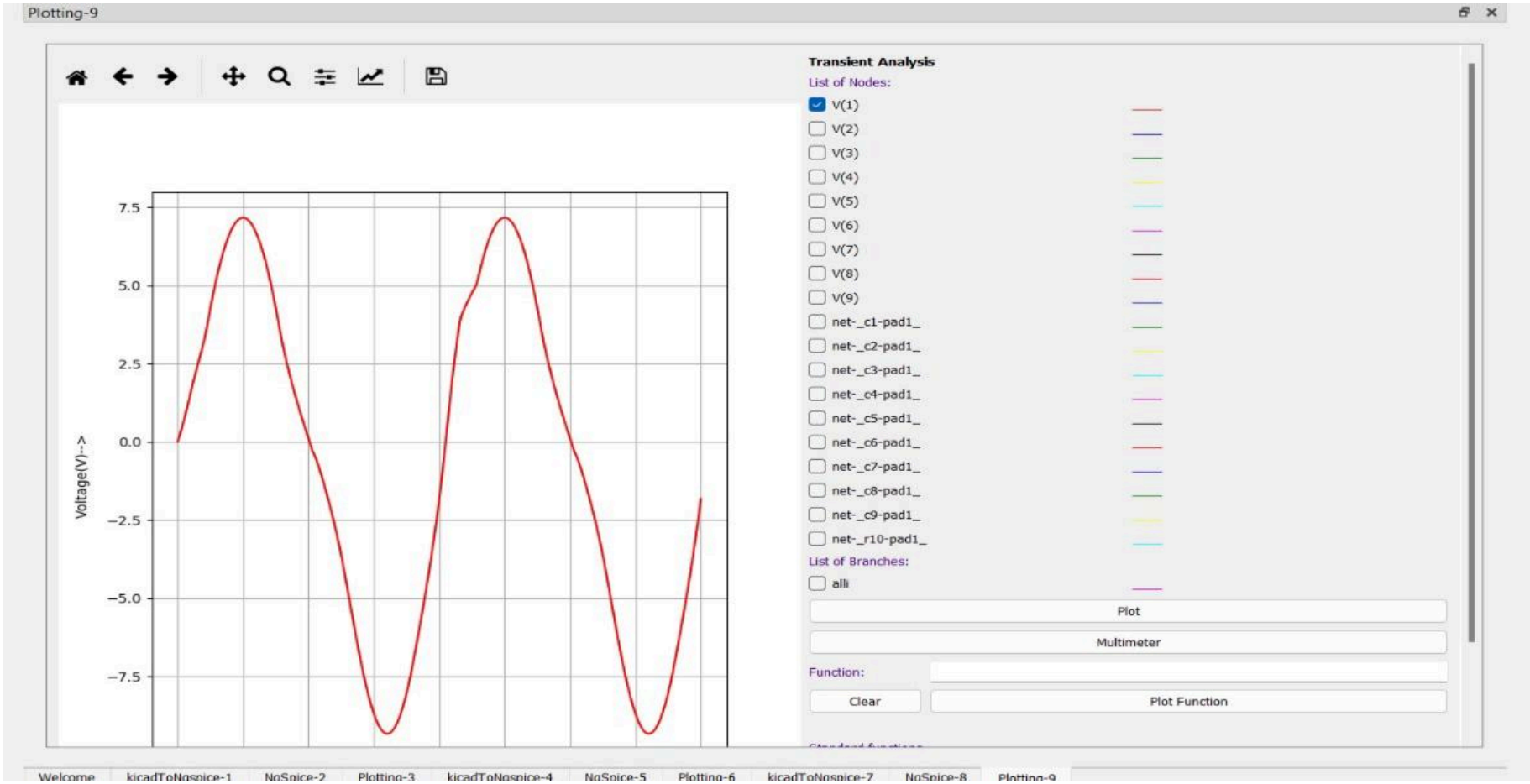
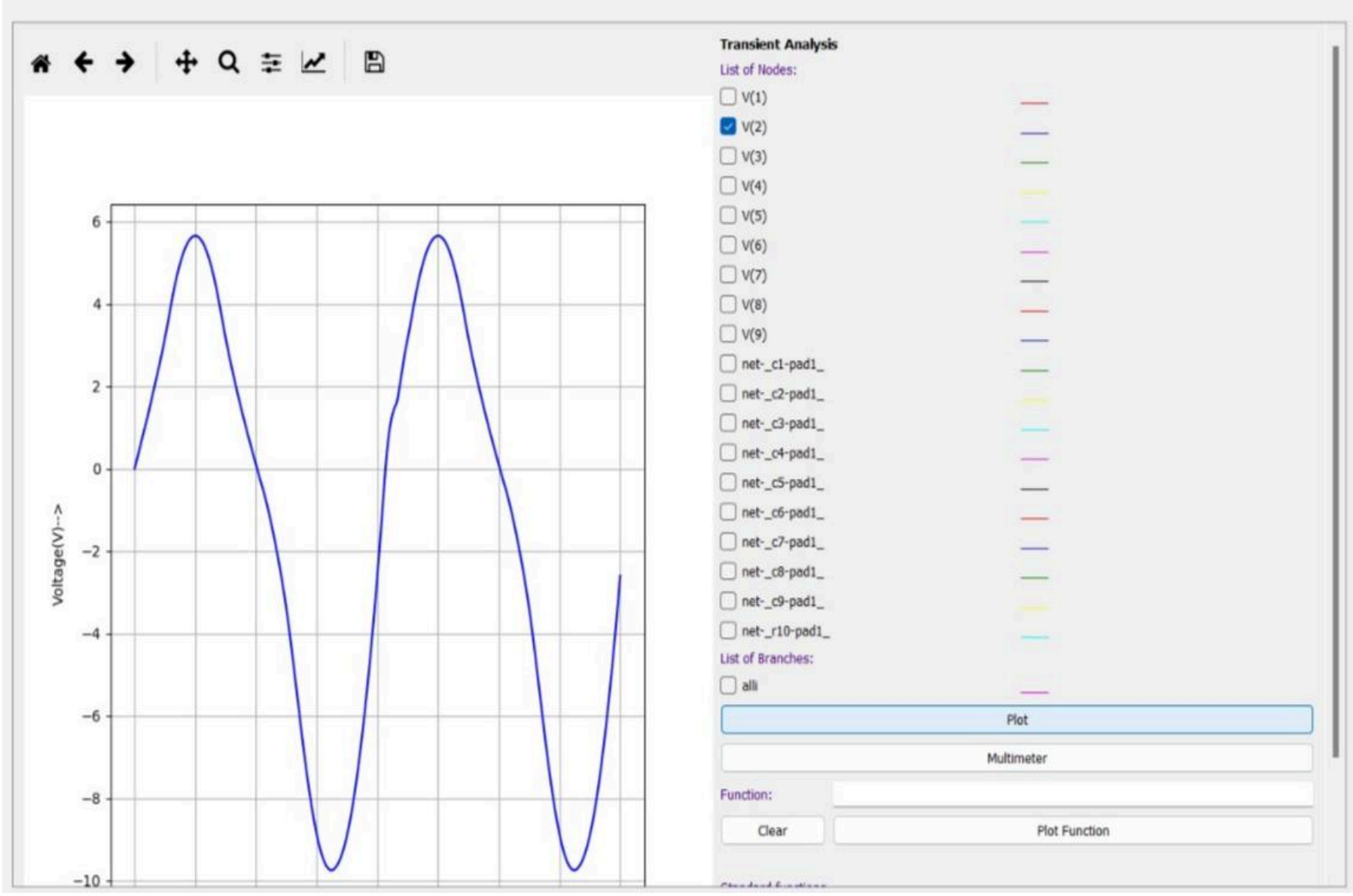
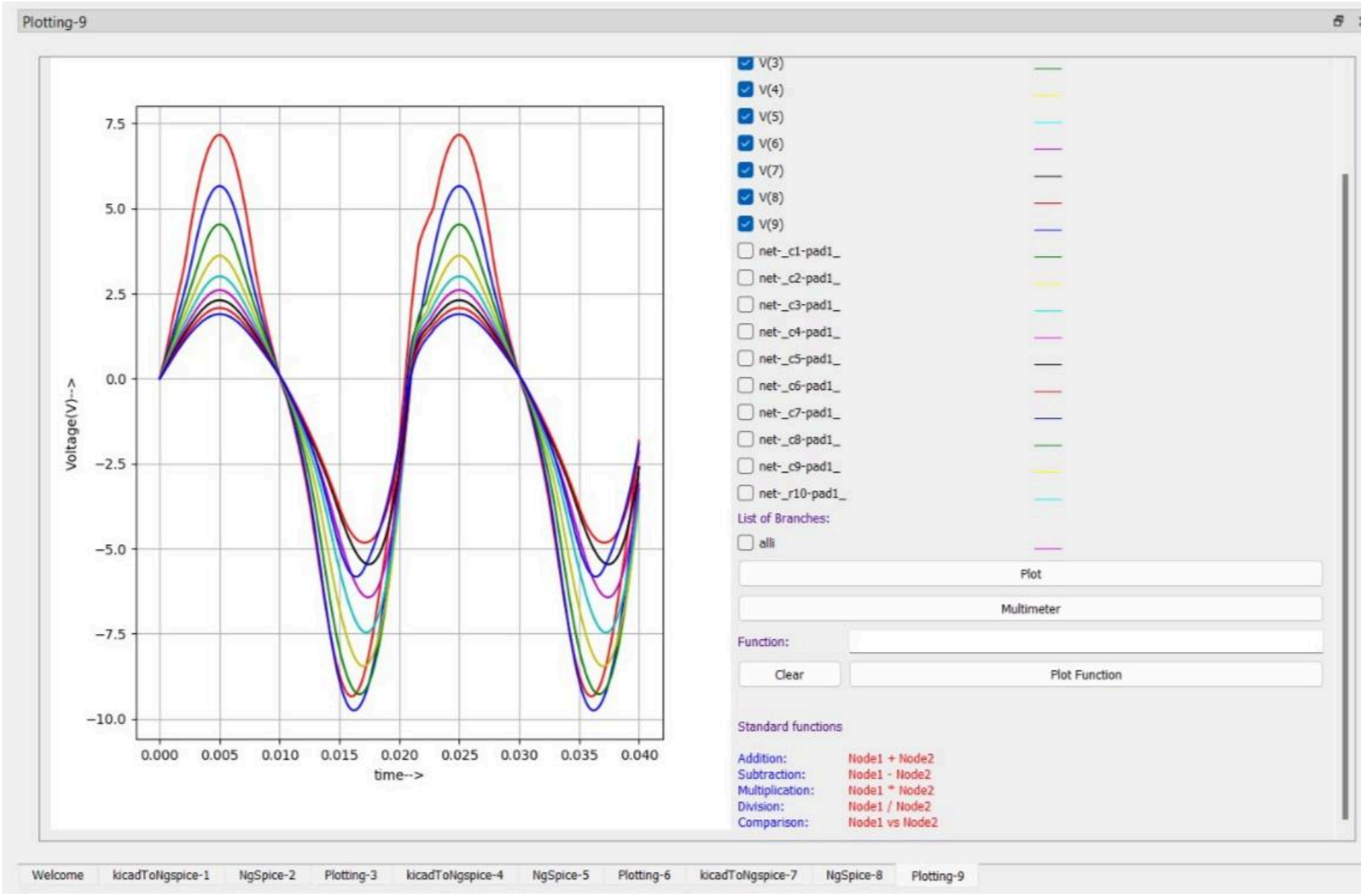


Figure : Ngspice output Sine Wave 9


Plotting-9
Transient Analysis
List of Nodes:
V(1)
V(2)
V(3)
V(4)
V(5)
V(6)
V(7)
V(8)
V(9)
net-_c1-pad1_
net-_c2-pad1_
net-_c3-pad1_
net-_c4-pad1_
net-_c5-pad1_
net-_c6-pad1_
net-_c7-pad1_
net-_c8-pad1_
net-_c9-pad1_
net-_r10-pad1_
List of Branches:
all
Plot
Multimeter
Function:
Clear
Plot Function
Voltage(V)-->
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
Welcome
kicadToNgspice-1
NgSpice-2
Plotting-3
kicadToNgspice-4
NgSpice-5
Plotting-6
kicadToNgspice-7
NgSpice-8
Plotting-9


Transient Analysis
List of Nodes:
V(1)
V(2)
V(3)
V(4)
V(5)
V(6)
V(7)
V(8)
V(9)
net-_c1-pad1_
net-_c2-pad1_
net-_c3-pad1_
net-_c4-pad1_
net-_c5-pad1_
net-_c6-pad1_
net-_c7-pad1_
net-_c8-pad1_
net-_c9-pad1_
net-_r10-pad1_
List of Branches:
all
Plot
Multimeter
Function:
Clear
Plot Function
Voltage(V)-->
6
4
2
0
−2
−4
−6
−8
−10


Plotting-9
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0
Voltage(V)-->
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
time-->
V(3)
V(4)
V(5)
V(6)
V(7)
V(8)
V(9)
net-_c1-pad1_
net-_c2-pad1_
net-_c3-pad1_
net-_c4-pad1_
net-_c5-pad1_
net-_c6-pad1_
net-_c7-pad1_
net-_c8-pad1_
net-_c9-pad1_
net-_r10-pad1_
List of Branches:
alli
Plot
Multimeter
Function:
Clear
Plot Function
Standard functions
Addition: Node1 + Node2
Subtraction: Node1 - Node2
Multiplication: Node1 * Node2
Division: Node1 / Node2
Comparison: Node1 vs Node2
Welcome
kicadToNgspice-1
NgSpice-2
Plotting-3
kicadToNgspice-4
NgSpice-5
Plotting-6
kicadToNgspice-7
NgSpice-8
Plotting-9

(a) Combined waveform of all the nine waves

(b) Legend

Conclusion:

Hence, three sine waves were generated and an appropriate waveform was obtained.

References:

https://www.homemade-circuits.com/3-phase-signal-generator-using/
https://microcontrollerslab.com/three-phase-sine-wave-generator/
https://circuitdigest.com/electronic-circuits/sine-wave-generator-circuit