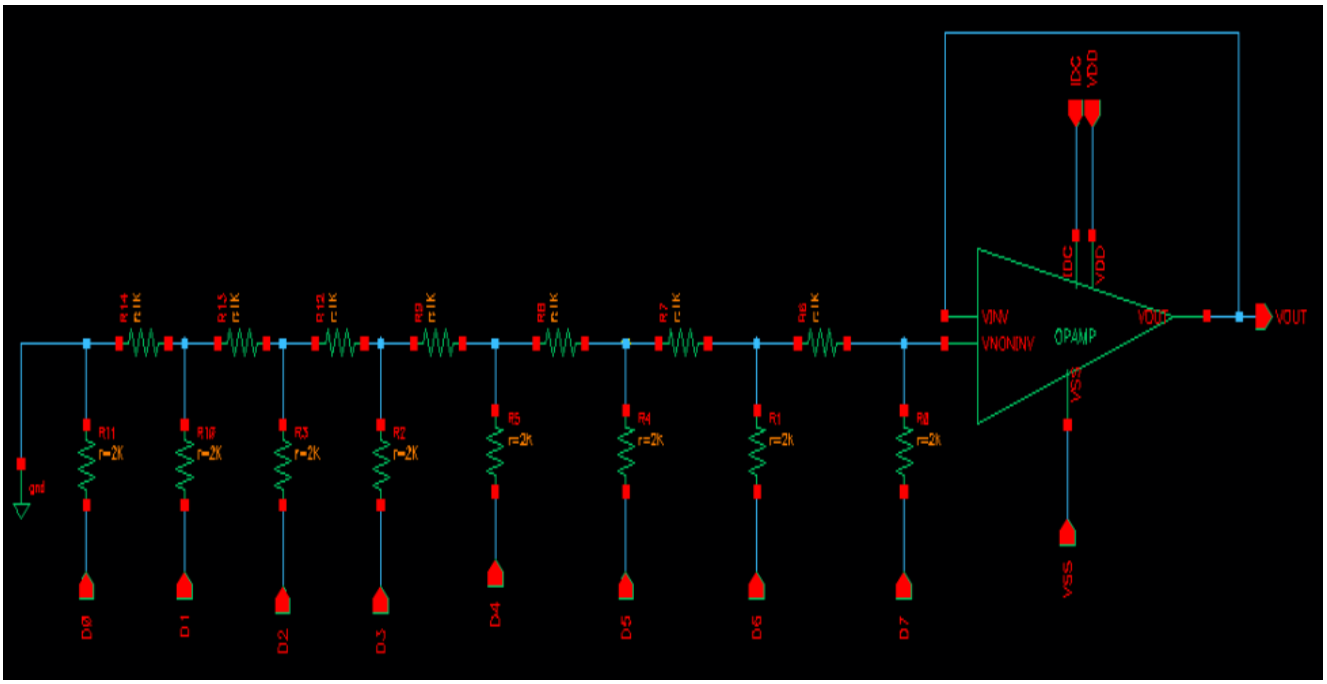
8-BIT R-2R DAC USING OP-AMP

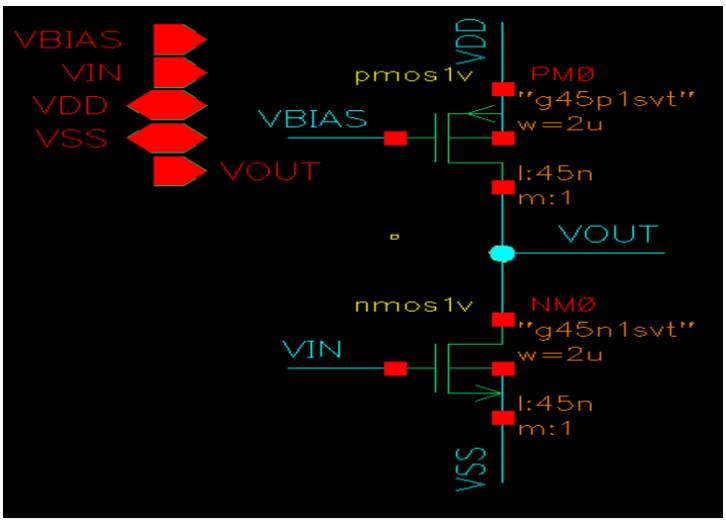
This document presents the simulation, design methodology, and output analysis of an 8-bit R–2R ladder Digital-to-Analog Converter (DAC) implemented using an operational amplifier.

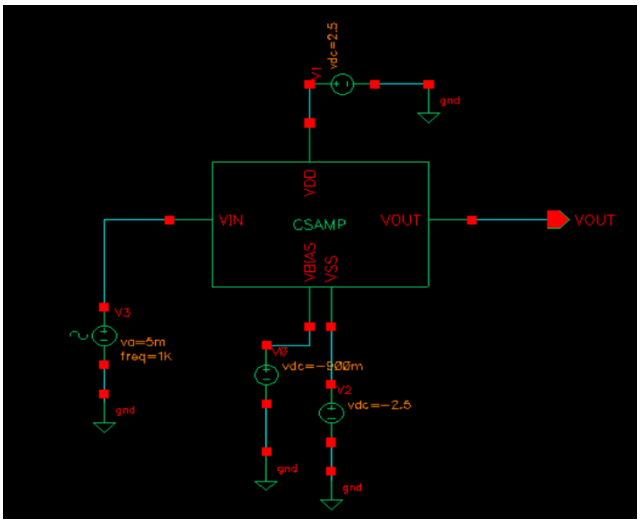
Schematic of R-2R ladder DAC



Methodology

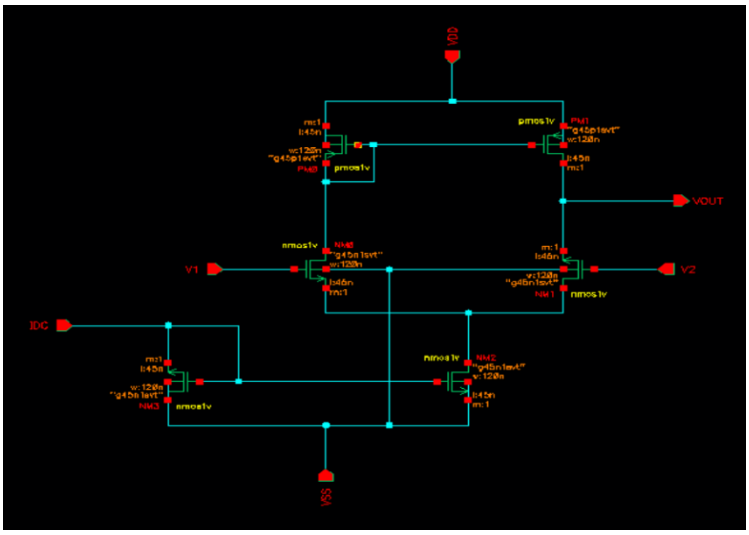
1. **Common Source Amplifier**
   A Common Source (CS) amplifier is a basic MOSFET amplifier configuration where the source terminal is common to both input and output (usually grounded). It provides voltage amplification and output is **180° out of phase** with input.

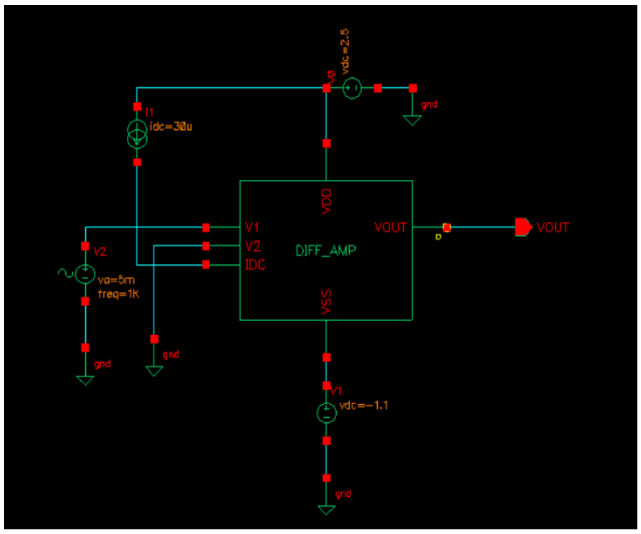




2. Differential Amplifier

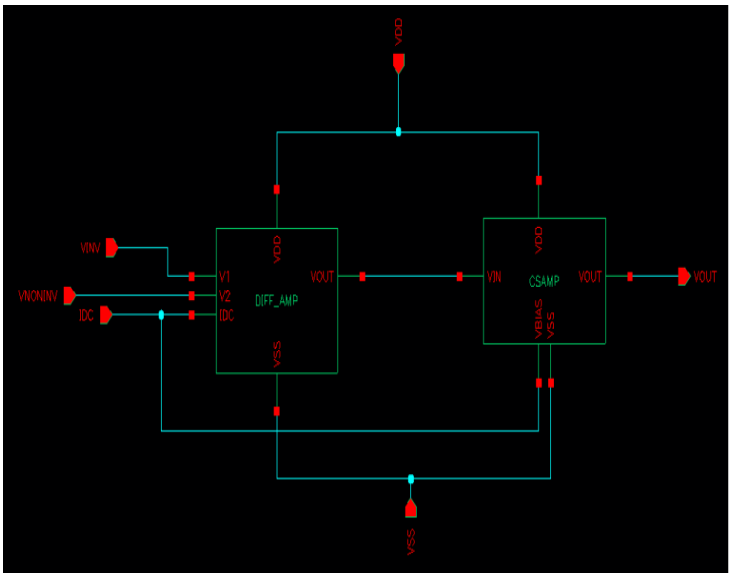
A differential amplifier (or differential pair) is a fundamental analog circuit that amplifies the difference between two input signals while rejecting any signal that is common to both inputs.

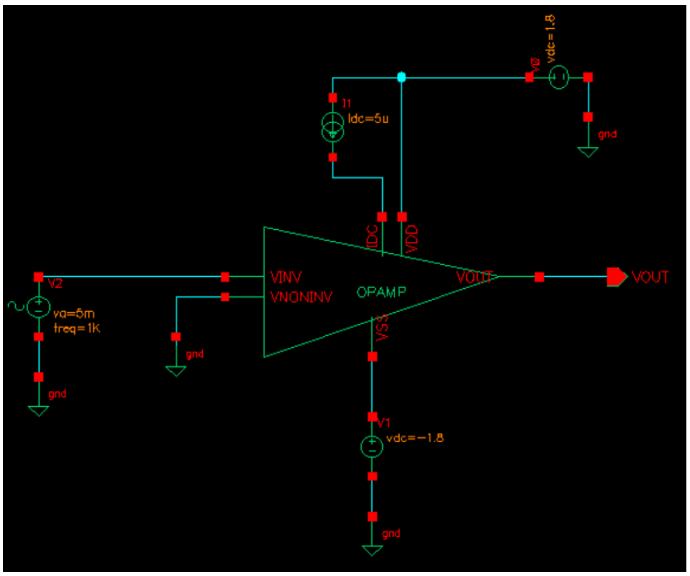




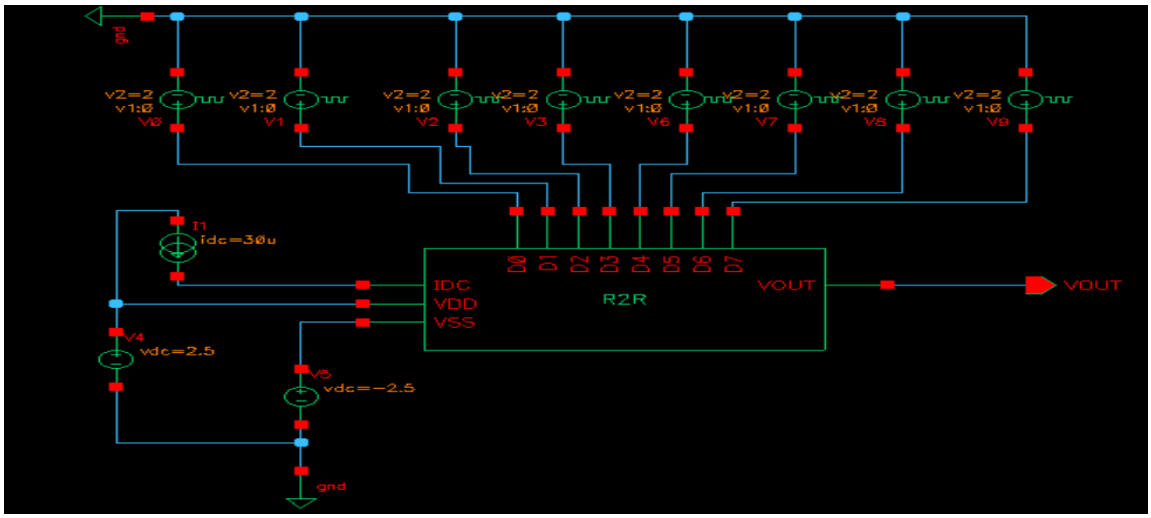
3. Op-amp

An **Operational Amplifier (Op-Amp)** is a **high-gain, differential-input, single-output amplifier** used for analog signal processing. It amplifies the **difference** between two input voltages.





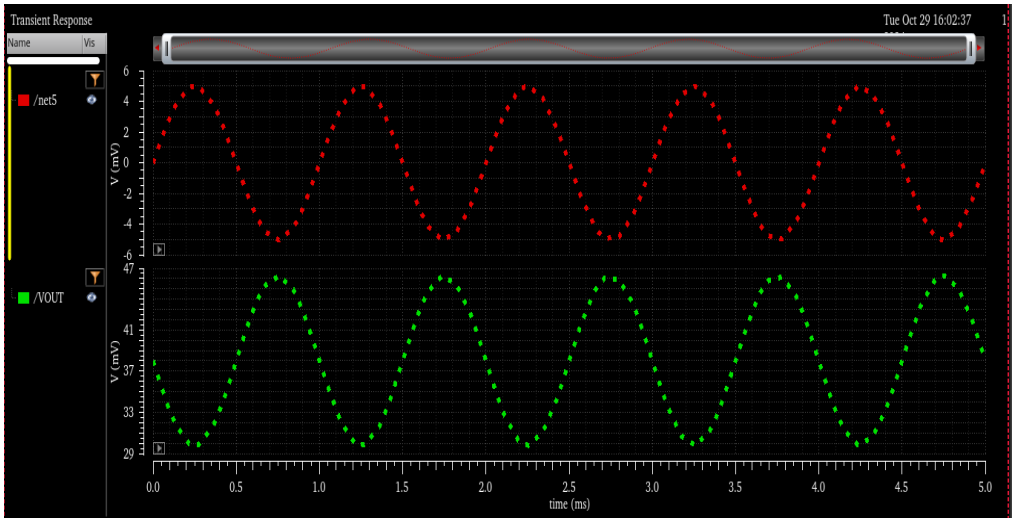
R-2R Test-Circuit



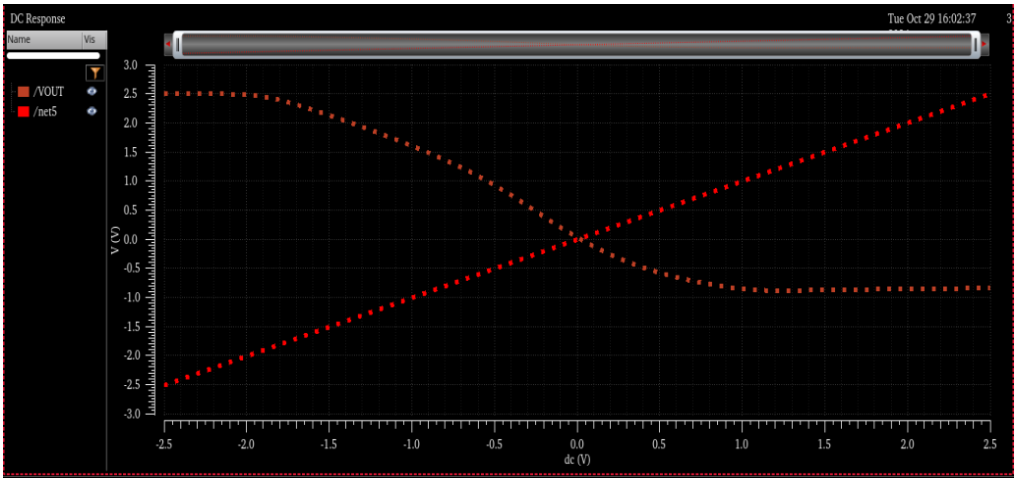
Simulation Results

Common Source Amplifier

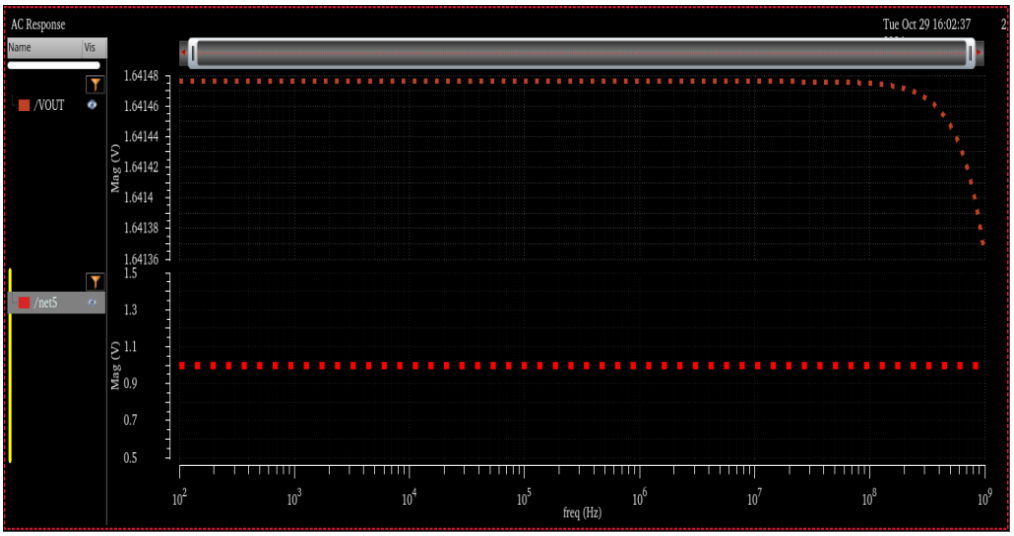
1. Transient Analysis



2. DC Response

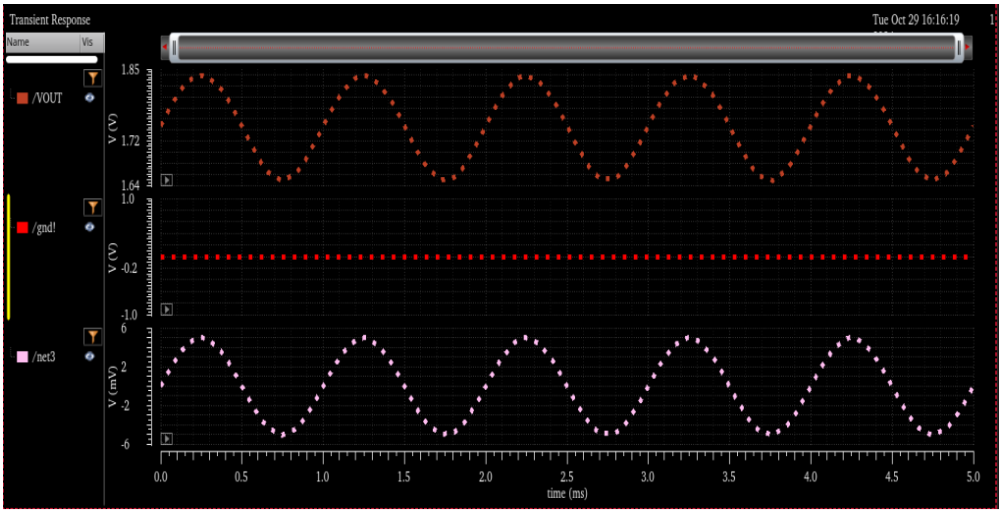


3. AC Response

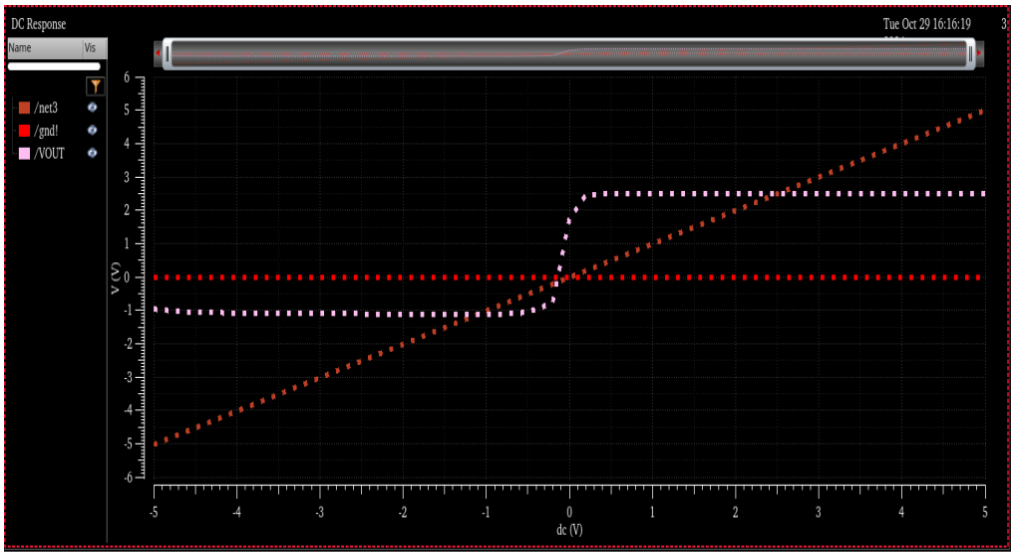


Differential Amplifier

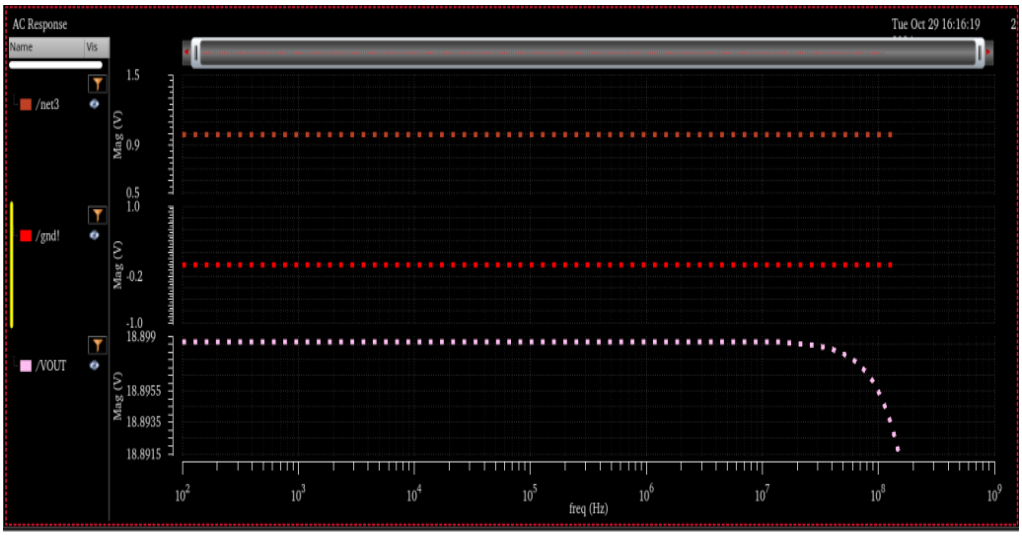
1. Transient Analysis



2. DC Response

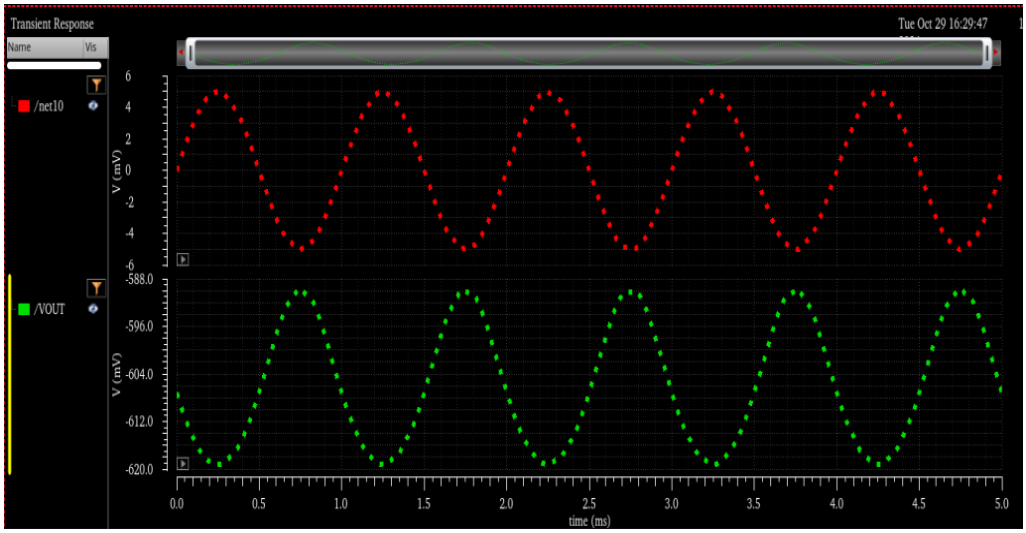


3. AC Response

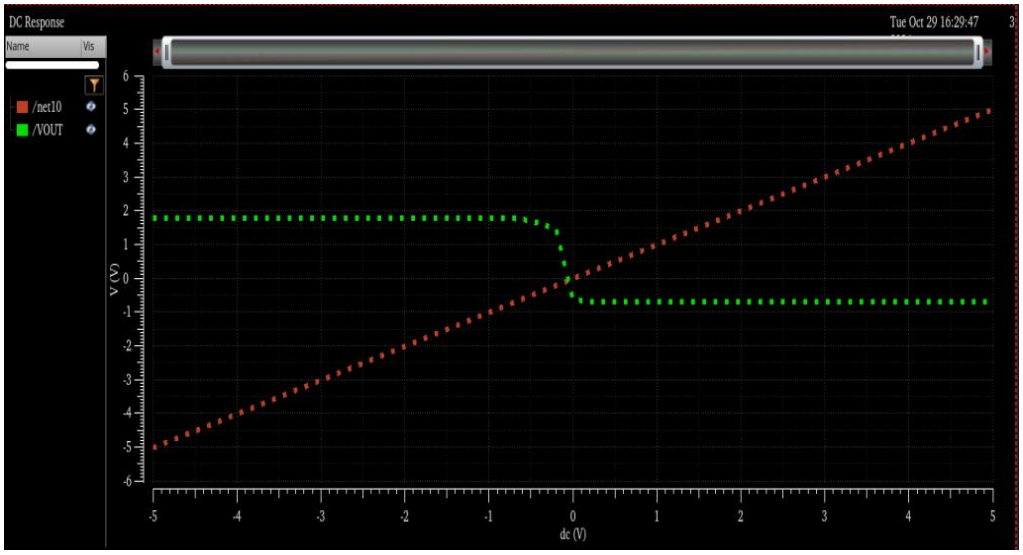


Operational Amplifier

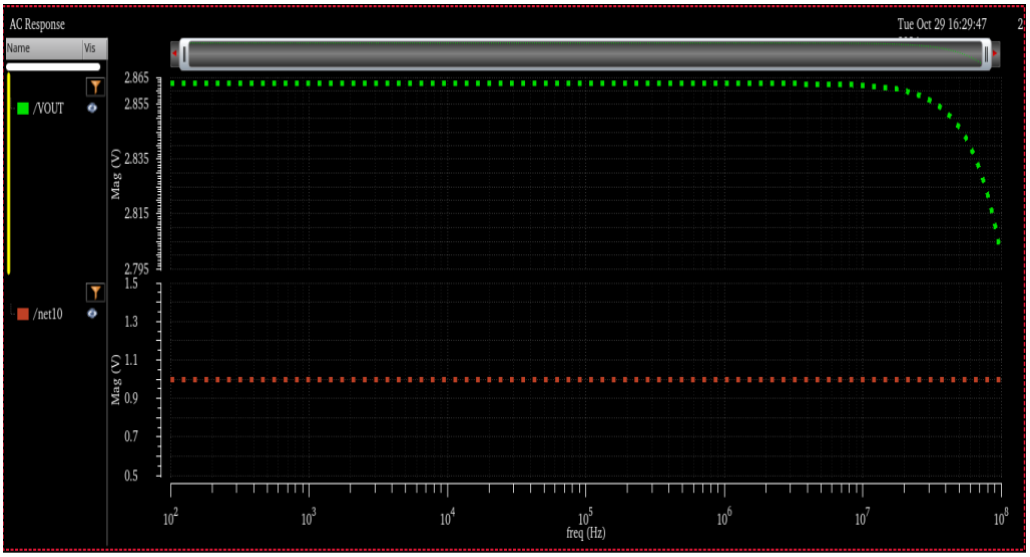
1. Transient Analysis



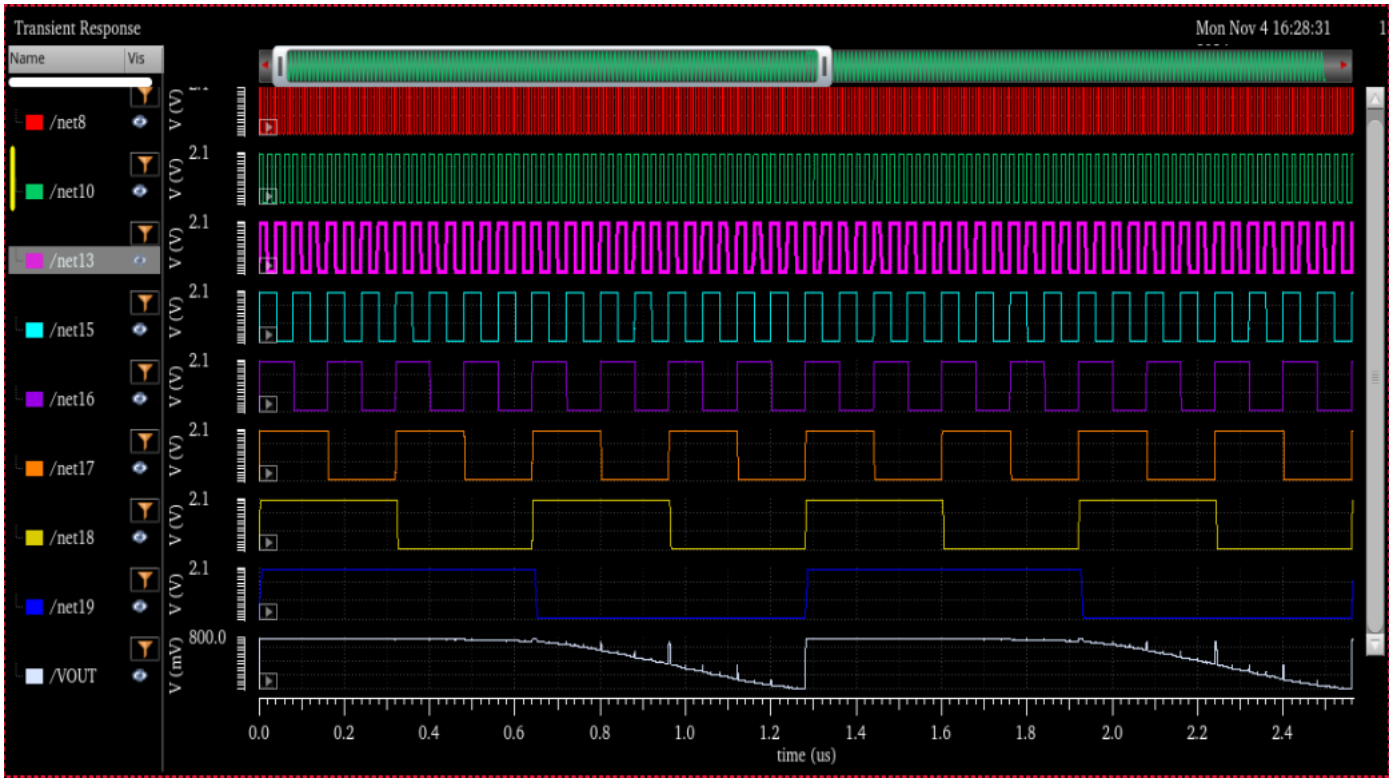
2. DC Response



3. AC Response



Final R-2R Ladder DAC Simulation



Conclusion

The R2R DAC relies on a resistor ladder network using only two resistor values: (R2R) This design allows for a simplified and scalable approach to digital-to-analog conversion.