R-2R LADDER USING OP-AMP
R-2R Ladder

- An enhancement of the binary-weighted resistor DAC is the R-2R ladder network. The R-2R network consists of resistors with only two values - R and 2xR. If each input is supplied either 0 volts or reference voltage, the output voltage will be an analog equivalent of the binary value of the three bits. D1 corresponds to the most significant bit (MSB) while D4 corresponds to the least significant bit (LSB).
Circuit Topology
For Binary Input 1111, the obtained Analog output from the R-2R ladder is -4.685.
An alternative to the binary-weighted-input DAC is the so-called R/2R DAC, which uses fewer unique resistor values.

A disadvantage of the former DAC design was its requirement of several different precise input resistor values: one unique value per binary input bit. Manufacture may be simplified if there are fewer different resistor values to purchase, stock, and sort prior to assembly. Of course, we could take our last DAC circuit and modify it to use a single input resistance value, by connecting multiple resistors together in series.

\[ V_{out} = -(V_{ref}) \times (\frac{Rf}{2R}) \times (\frac{D_1}{2} + \frac{D_2}{4} + \frac{D_3}{8} + \frac{D_4}{16}) \]
- Each Bit controls a switch between ground and the inverting input of the op amp.

- The switch is connected to ground if the corresponding bit = 0.

- Switch for bit 0 is connected to op amp input. All other switches connected to ground.

- Non-inverting input is connected to ground. Therefore, inverting input is at virtual ground.

- This is the Simplest type of DAC and Requires only two precision resistance value (R and 2R).
Conclusion

- As the case with the binary-weighted DAC design, we can modify the value of the feedback resistor to obtain any "span" desired.

- Thus the R-2R ladder logic is implemented using Op Amp 741, simulated output waveform is implemented using the Solid thinking Activate tool.