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Title of the circuit: Binary weighted resistor DAC

Theory: Digital-to-Analogue Converters, or DAC's as they are more commonly known, are the opposite of the Analogue-to-Digital Converters. DAC's convert binary or non-binary numbers and codes into analogue ones with its output voltage (or current) being proportional to the value of its digital input number. For example, we may have a 4-bit digital logic circuit that ranges from 0000 to 1111_2, (0 to F_{16}) which a DAC converts to a voltage output ranging from 0 to 10V.

Converting an "n"-bit digital input code into an equivalent analogue output voltage between 0 and some V_{MAX} value can be done in a number of ways, but the most common and easily understood conversion methods uses a weighted resistors and a summing amplifier, or a R-2R resistor ladder network and operational amplifier. Both *digital-to-analogue conversion* methods produce a weighted sum output, with the weights set by the resistive values used in the ladder networks contributing a different "weighted" amount to the signals output.

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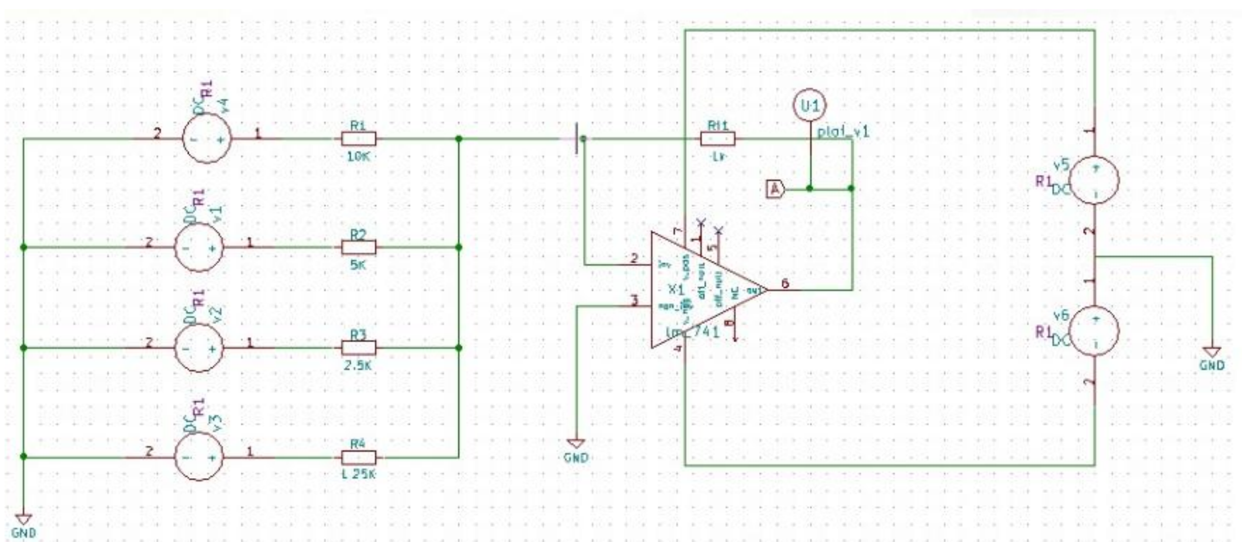
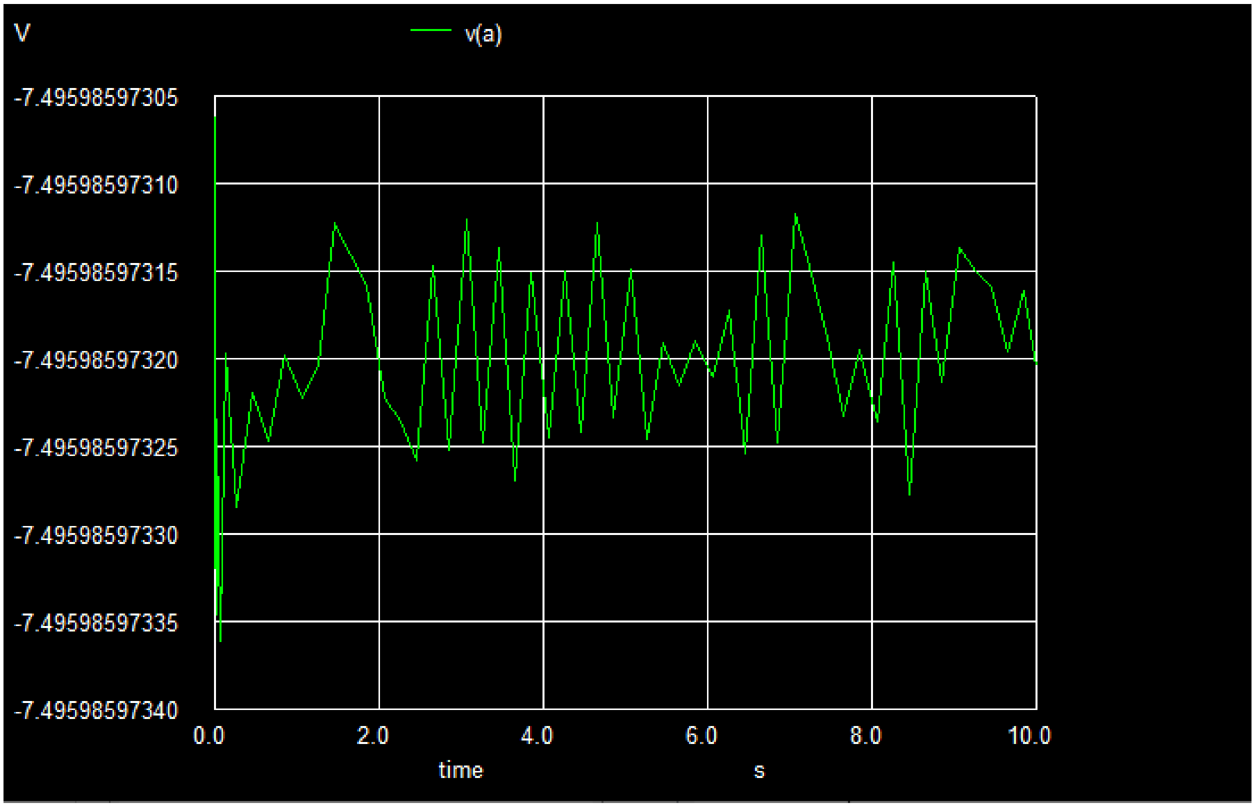
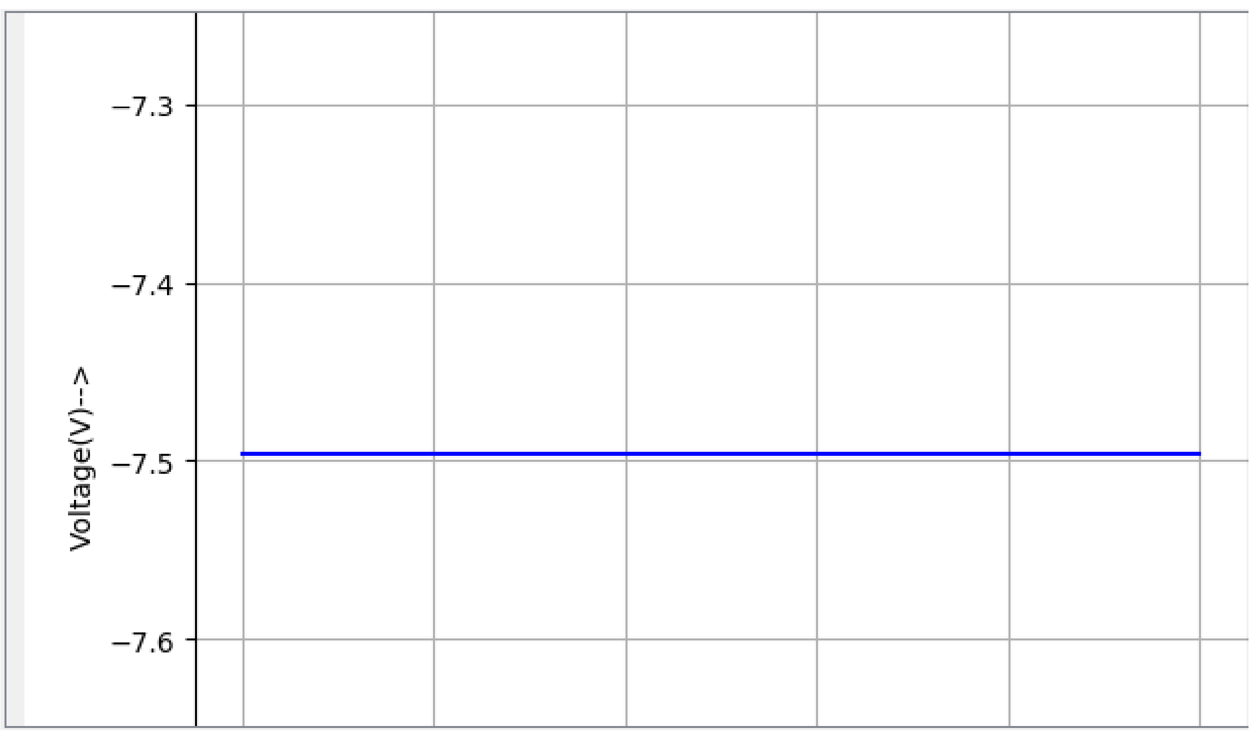
Schematic:



Ngspice plots:



Python plots:



References:

1. **binary weighted resistor by Ramakanth A.Gayakwad 4th edition, pearson publication.**
2. **https://www.electronics-tutorials.ws/combination/digital-to-analogue-converter.html**