1. Binary-Weighted Resistors DAC

Input Logic	V_o	Input Logic	V_o
0000 [00]	0	1000 [08]	-2.65
0001 [01]	-0.332	1001 [09]	-2.99
0010 [02]	-0.669	1010 [10]	-3.32
0011 [03]	-1.003	1011 [11]	-3.65
0100 [04]	-1.345	1100 [12]	-3.99
0101 [05]	-1.679	1101 [13]	-4.33
0110 [06]	-2.017	1110 [14]	-4.67
0111 [07]	-2.35	1111 [15]	-5.00

2. R-2R DAC Circuit

Input Logic	V_o	Input Logic	V_o
0000 [00]	0	1000 [08]	-0.676
0001 [01]	-0.082	1001 [09]	-0.761
0010 [02]	-0.169	1010 [10]	-0.848
0011 [03]	-0.255	1011 [11]	-0.934
0100 [04]	-0.340	1100 [12]	-1.019
0101 [05]	-0.420	1101 [13]	-1.015
0110 [06]	-0.513	1110 [14]	-1.191

3. Analysis

Please write concisely your observation and critical analysis for each experiment results. You may refer to the table caption for ease of analysis. You may add additional paper if necessary.

In this experiment the objective is to design, build and test digital to analog converter (DAC). The DAC will be implementing 4-bit DAC.

Binary Weighted Resistor DAC :
In this experiment, Inverting summing amplifier circuit is used. And it generates negative sum of input voltages. Results are based on R, 2R, 4R and 8R resist configuration in circuit. In DAC, potentiometer is used to adjust value of feedback resistance. Rf is adjusted so that closed loop gain of the op-amp can be changed. In return, our output for '1111' is 5V. When Rx = R, the gain will be 1. And the output voltage will equal to input voltage for logic '1000'. However, outp voltage decreases linearly as it reaches -5V. As input voltage was bound to inverting input terminal of the op-amp, the output voltages will all be negative. However, Binary weighted resistors have some downsides. As the number of bits in digital input increases, resistance value corresponding to MSB and LSB also increases. Because of this, high precision resistors are needed, which are both expensive and impractical.

R-2R DAC Circuit:
Since it only has two resistor values on the input side, R and 2R, this method overcomes the drawback of the binary weighted resistor DAC hence it is simple build and manage. Rx is equal to R/N in this system, where R is the value of the resistor and N is the number of resistor networks/number of bits.
Because of the value of Rx, the output voltages progressively decrease and become increasingly far from the desired output. When comparing the output voltages of '0001' and '1000,' it can be shown that '1000' is approximately 8 times higher than '0001,' which is equivalent in a binary weighted resistor DAC circuit. This means that this conversion is similar to the binary weighted resistor DAC, but with a smaller number of resistors. But a disadvantage of it is that it converts at a slower rate.

4. Conclusions

We can conclude that R-2R DAC is a much better circuit than binary weighted resistor DAC. The binary weighted resistor DAC uses only one resistor per resistor network, but since it requires a large variety of resistor values, it is more expensive and harder to manage than the R-2R DAC. The objective of this lab is to build, test and understand digital to analog converter (DAC) and analog to digital converter (ADC) hence this lab is a success as all of the objectives are met.