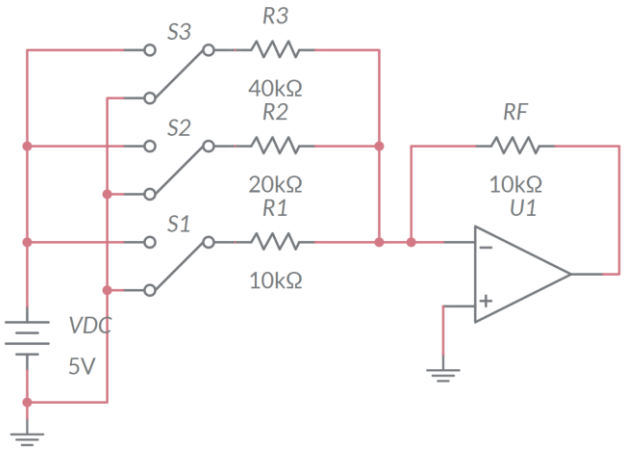
LAB 9: DIGITAL-TO-ANALOG CONVERTER

1. Goals

- Understand the working principle of basic digital-to-analog converters (DAC) .
- Know to build up and analyze basic digital-to-analog converters.

2. Exercises

Exercise 1. Build up and analyze the working principle of a 3-bit binary weighted resistor DAC shown in Figure 1.



$$Vo = -\left(\frac{R_F}{R1}V_1 + \frac{R_F}{R2}V_2 + \frac{R_F}{R3}V_3\right)$$

Figure 1. Circuit diagram of a 3-bit binary weighted resistor DAC.

Requirements:

- Implement the circuit in Figure 1 on a breadboard.
- Set V_{ref} = 5 V and bias the op-amp with V^+ = 15 V and V^- = -15 V.
- Use a multimeter to measure the output voltage for each combination of the inputs ($S_1S_2S_3$ = 000 ~ 111).
- Record the measurements and compare them with the theory.

Exercise 2. Build up and analyze the working principle of a 4-bit R-2R ladder DAC shown in Figure 2. Note: R_F = R = 10kΩ.

$$Vo = -\frac{R_F}{R}\left(\frac{V_1 + 2V_2 + 4V_3 + 8V_4}{2^4}\right)$$

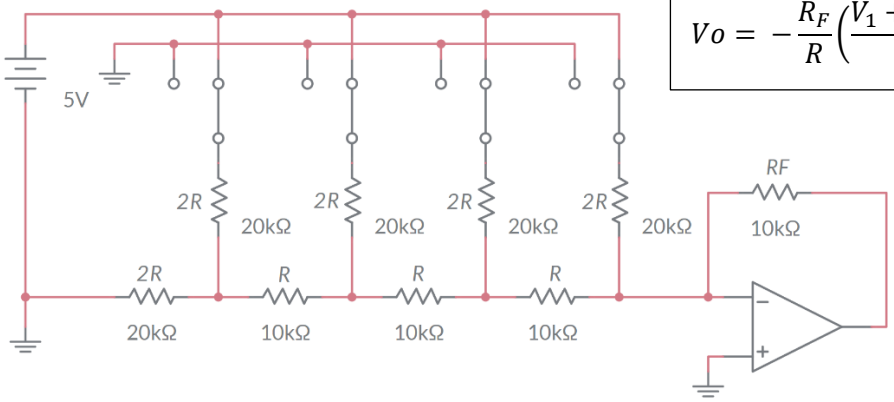


Figure 2. Circuit diagram of a 4-bit R-2R ladder DAC.

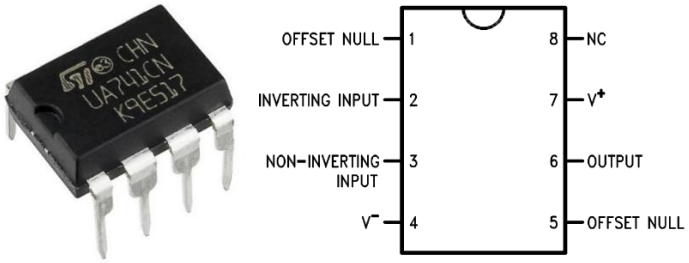
Requirements:

- Implement the circuit in Figure 2 on a breadboard.
- Set V_{ref} = 5 V and bias the op-amp with V^+ = 15 V and V^- = -15 V.
- Use a multimeter to measure the output voltage corresponding to the different combinations of the input ($S_1S_2S_3S_4$ = 0000 ~ 1111).
- Record the measurements and compare them with the theory.

Components and devices needed for the lab:

Components and Devices	Description	Amount
Op-amp	IC 741	2
Resistor	10 kΩ	Few
Switch	3-pin	4
DC power supply	Aditeg PS-3030DD	1
Breadboard		1
Wire		Few
Multimeter		1

→ The datasheet of LM741 can be found here.



LM741 PINOUT