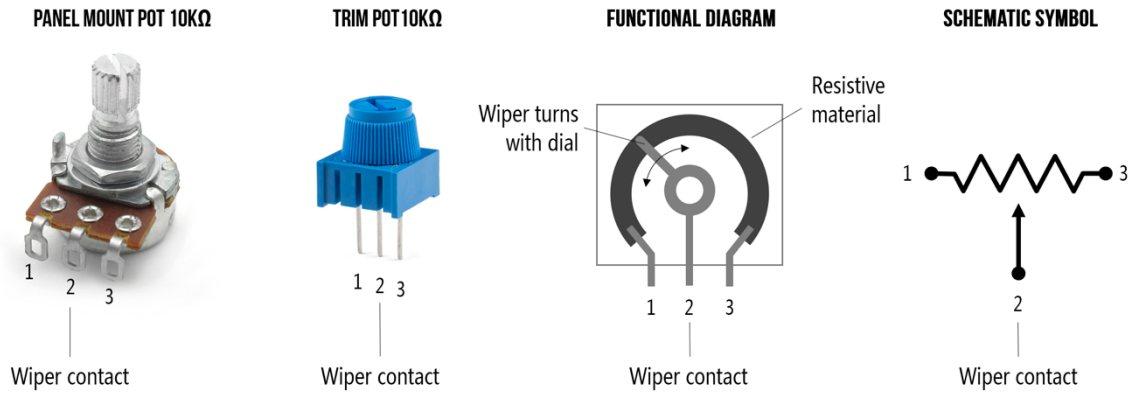
Lab 1 – Potentiometers

Experiment 1: The Potentiometer-Capacitor Circuit

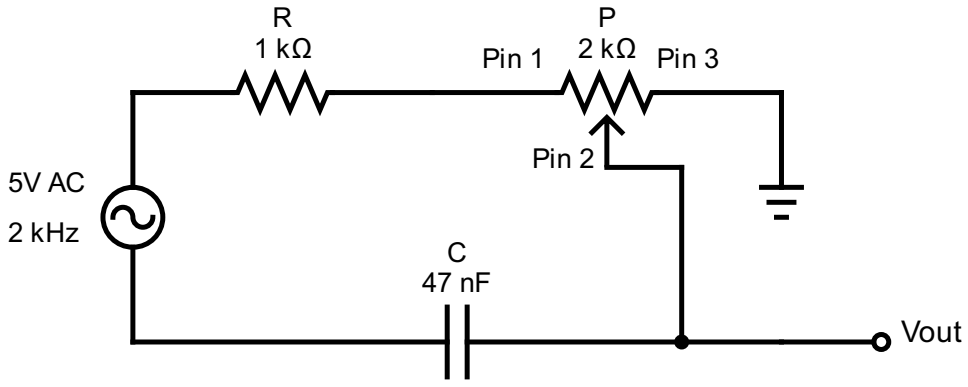
This experiment explores the behaviour of a simple RC (Resistor-Capacitor) circuit and understand its response to changes in input voltage. To achieve this, we will use a linear potentiometer as a variable resistor in the circuit.



A potentiometer, often referred to as a pot, is a three-terminal resistor with an adjustable tap that allows us to change the resistance value along its length. In this experiment, we will utilize a linear potentiometer to vary the resistance in the RC circuit. By adjusting the potentiometer, we can control the rate at which the capacitor charges and discharges, thus influencing the time constant and the behaviour of the circuit.

Experimental Procedure:

Part 1: Setup and Investigation



1. Set up the circuit shown above, using a signal generator to provide a 5V AC signal at a frequency of 2 kHz.
2. Using the digital oscilloscope, add probes to examine the peak-to-peak voltage across Pins 1 and 2 of the potentiometer V_P, and across the capacitor V_C.

3. Starting with the potentiometer at 0% (full left), take 6 readings of V_P and V_C up to 100% (full right).
4. Repeat this process with the AC signal frequency set to 2 kHz, 5kHz, 10 kHz, 20 kHz, 50 kHz, and 100 kHz.
5. For each of the frequencies, on a single graph plot V_P vs. V_C.

Part 2: Simulation using NI Multisim

1. Set up the circuit shown above in Multisim, using an AC source providing 5V signal at a frequency of 1 kHz.
2. Add voltage probes to examine the peak-to-peak voltage across the potentiometer V_P, and across the capacitor V_C. Set each probe to Periodic measurement label to display peak-to-peak voltages.
3. Place a reference pin on the negative side of each component, and set each voltage probe to the appropriate reference.
4. Start the simulation in Interactive mode, and ensure that it is behaving correctly.
5. Similar to Part 1, starting with the potentiometer at 0.5% (full left), take 6 readings of V_P and V_C up to 100% (full right).
6. Repeat this process with the AC signal frequency set to 2 kHz, 5kHz, 10 kHz, 20 kHz, 50 kHz, and 100 kHz.
7. For each of the frequencies, plot of graph of V_P vs. V_C.

Part 3: AC Sweep Simulation

8. With the potentiometer set to 0.5%, run an AC Sweep simulation produce a graph of the circuit's response and determine the cut-off frequency.

   Note: the cut-off frequency f_c is defined the point at which the output voltage is equal to -3 dB (or 70%) of the input voltage, where:

$$f_c = \frac{1}{2\pi RC}$$

9. Repeat the AC Sweep with the potentiometer set to 100% and determine the cut-off frequency, and hence the full adjustable frequency range of the circuit.