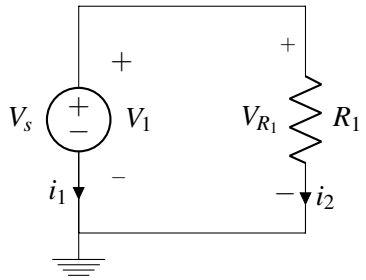
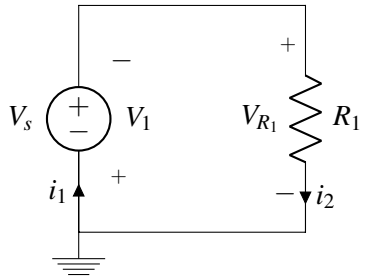
EECS 16A Designing Information Devices and Systems I
Fall 2018 Discussion 7B

1. Passive Sign Convention and Power

(a) Suppose we have the following circuit and label the currents as shown below. Calculate the power dissipated or supplied by every element in the circuit. Let $V_s = 5\,\text{V}$ and let $R_1 = 5\,\Omega$.

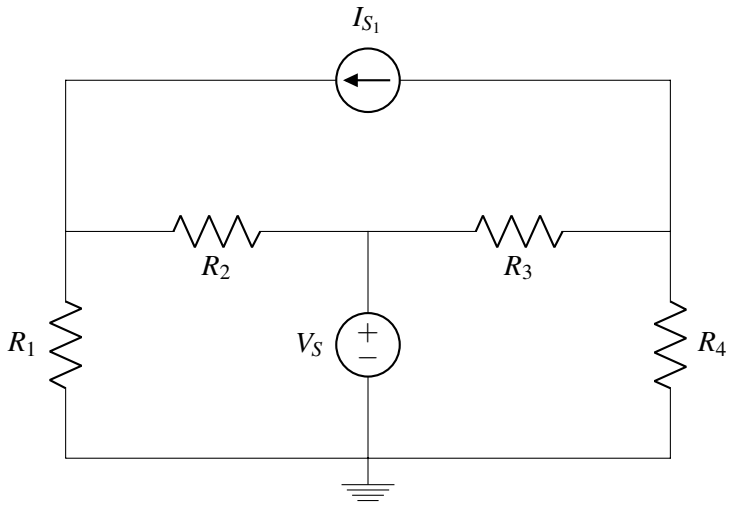


(b) Suppose we change the label of the currents in the circuit to be as shown below. Calculate the power dissipated or supplied by every element in the circuit. Let $V_s = 5\,\text{V}$ and let $R_1 = 5\,\Omega$.



2. Circuit Analysis

Setup the matrix to solve for the voltages across and the currents flowing through each component.



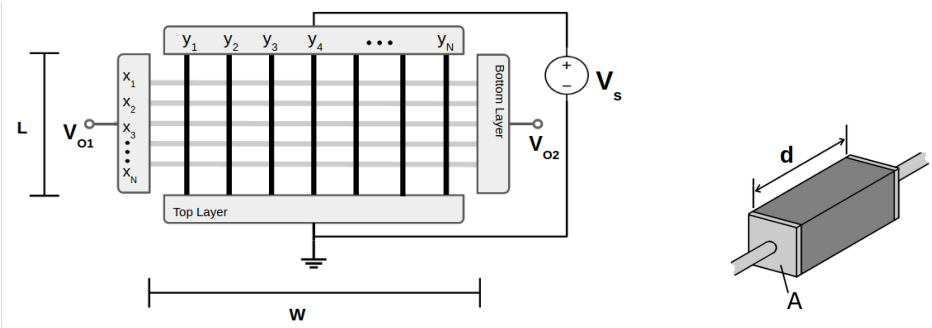
3. Resist the Touch

In this question, we will be re-examining the 2-dimensional resistive touchscreen previously discussed in both lecture and lab. The general touch screen is shown in Figure 1 (a). The touchscreen has length L and width W and is composed of a rigid bottom layer and a flexible upper layer. The strips of a single layer are all connected by an ideal conducting plate on each side. The upper left corner is position $(1,1)$.

The top layer has N vertical strips denoted by $y_1, y_2, ..., y_N$. These vertical strips all have cross sectional area A, and resistivity ρ_y.

The bottom layer has N horizontal strips denoted by $x_1, x_2, ..., x_N$. These horizontal strips all have cross sectional area A as well, and resistivitiy ρ_x.

Assume that all top layer resistive strips and bottom layer resistive strips are spaced apart equally. Also assume that all resistive strips are rectangular as shown by Figure 1 (b).



(a) 2-D Resistive Touch Screen

(b) 3D Model of a Single Resistive Strip

Figure 1:

(a) (3 points) Figure 1(b) shows a model for a single resistive strip. Find the equivalent resistance R_y for the vertical strips and R_x for the horizontal strips, as a function of the screen dimensions W and L, the respective resistivities, and the cross-sectional area A.

(b) (5 points) Consider a 2×2 example for the touchscreen circuit.
Given that $V_s = 3\,\text{V}$, $R_x = 2000\,\Omega$, and $R_y = 2000\,\Omega$, draw the equivalent circuit for when the point $(2,2)$ is pressed and solve for the voltage at terminal V_{O2} with respect to ground.

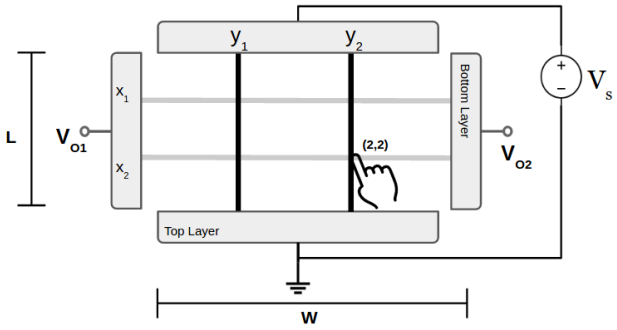


Figure 2: 2×2 Case of the Resistive Touchscreen

(c) (8 points) Suppose a touch occurs at coordinates (i, j) in Figure 1(a). Find an expression for V_{O2} as a function of V_s, N, i, and j. The upper left corner is the coordinate $(1, 1)$ and the upper right coordinate is $(N, 1)$.