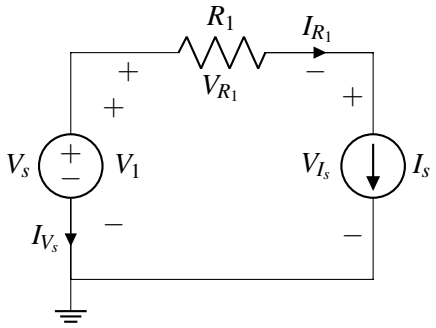
EECS 16A Designing Information Devices and Systems I
Summer 2020 Discussion 3D

1. Passive Sign Convention and Power v 2.0

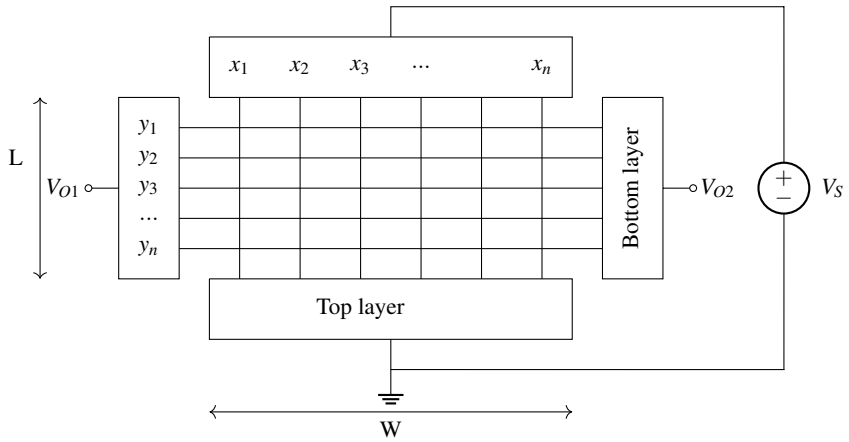
Suppose we have the following circuit and label the currents as shown below. Calculate the power dissipated or supplied by every element in the circuit. Let $V_s = 5\,\text{V}, I_s = 0.5\,\text{A}$ and $R_1 = 5\,\Omega$.



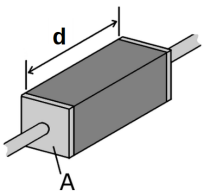
2. Resist the Touch

In this question, we will be re-examining the 2-dimensional resistive touchscreen which we previously discussed in lecture and will soon also see in 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 $x_1, x_2, ..., x_N$. These vertical strips all have cross sectional area A, and resistivity ρ_x.



(a) 2-D Resistive Touch Screen



(b) 3D Model of a Single Resistive Strip

Figure 1: Model and components of a general touchscreen

The bottom layer has N horizontal strips denoted by $y_1, y_2, ..., y_N$. These horizontal strips all have cross sectional area A as well, and resistivity ρ_y.

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

(b) Consider a 2×2 example for the touchscreen circuit as in shown in Figure 2.

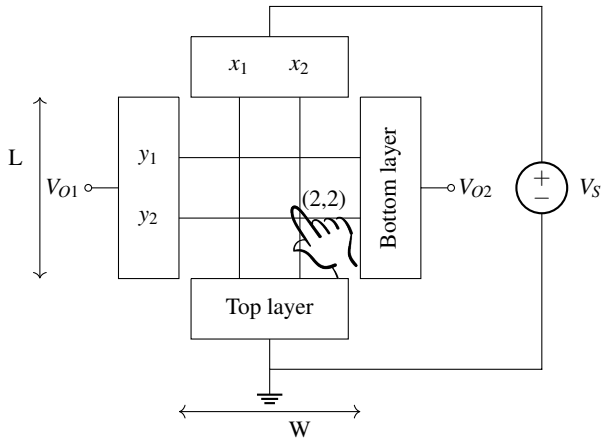


Figure 2: 2×2 Case of the Resistive Touchscreen

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.

(c) 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 $(N,1)$.

3. Practice: Series and Parallel Combinations

For the resistor network shown below, find an equivalent resistance between the terminals A and B using the resistor combination rules for series and parallel resistors.