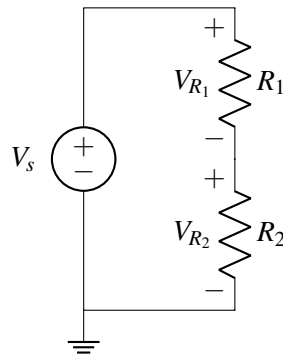
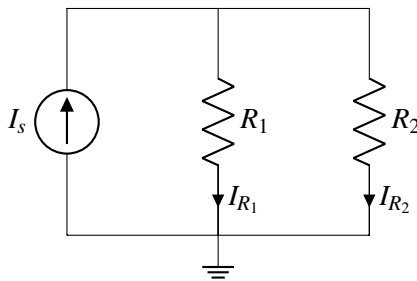

EECS 16A Designing Information Devices and Systems I
 Spring 2022 Discussion 7B

1. Volt and Ammeter

- (a) For the voltage divider below, how would we connect a voltmeter to the circuit to measure the voltage V_{R_2} ?



- (b) What would happen if we accidentally connected an ammeter in the same configuration instead? Assume our ammeter is ideal.
- (c) For the current divider below, how would we connect an ammeter to the circuit to measure the current I_{R_2} ?



- (d) What would happen if we accidentally connected a voltmeter in that configuration instead? Assume the voltmeter is ideal.

2. Resist the Touch

In this question we will be re-examining the 2-dimensional resistive touchscreen. This touchscreen is slightly different from the one shown in lecture and more like the one we will be examining in lab.

The touchscreen has length L and width W and is composed of a rigid bottom-layer and a flexible top-layer. Instead of having two continuous resistive sheets on the top and bottom layers, this is a simpler implementation with N vertical strips of conductive material in the top layer and N horizontal strips of conductive material in the bottom layer. The strips of a single layer are all connected by an ideal conducting plate on each side. All strips have resistivity, ρ , and cross-sectional area, A .

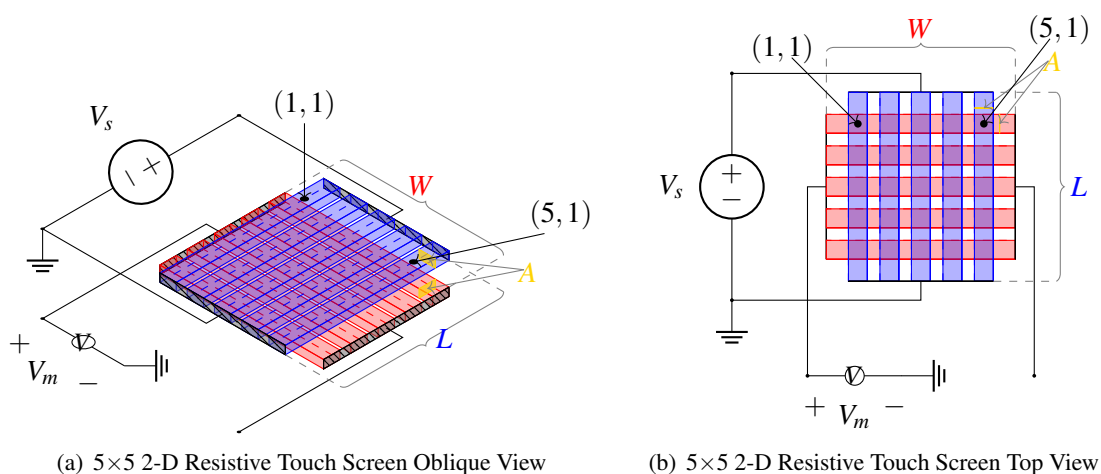


Figure 1: $N \times N$ Resistive Touch Screen, $N = 5$

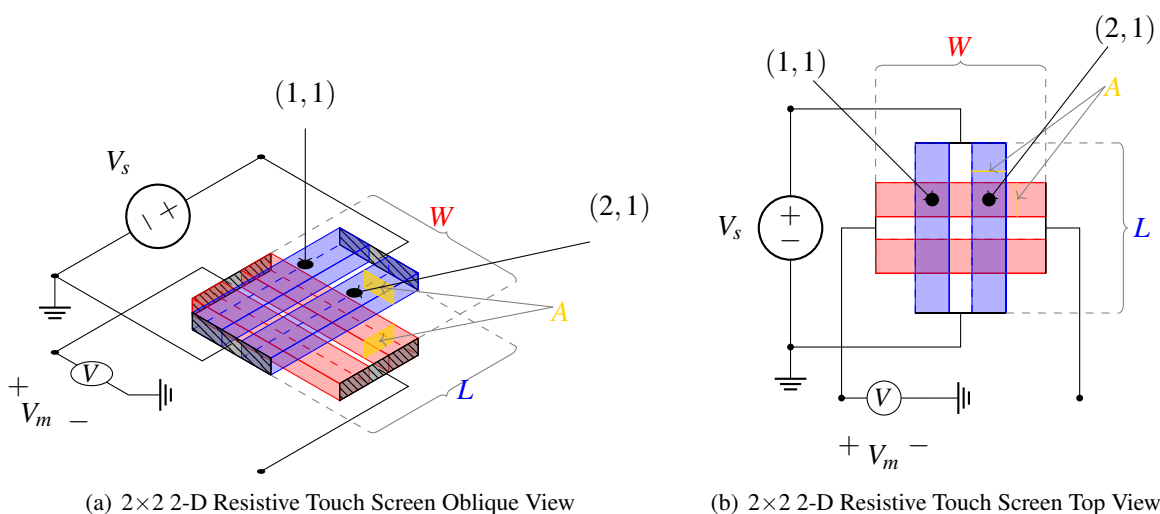


Figure 2: 2×2 Resistive Touch Screen

Assume that all top layer resistive strips and bottom layer resistive strips are spaced apart equally, and that the upper left touch point in Figure 1(b) is position $(1, 1)$, and the upper right touch point is $(N, 1)$. The spacing between the strips in the top layer is $\frac{W}{N+1}$, and the spacing between the strips in the bottom layer is $\frac{L}{N+1}$.

- Find the resistance R_y for a single vertical blue strip and R_x for a single horizontal red strip as a function of the screen dimensions W and L , the strip resistivity ρ , and the cross-sectional area A .
- Consider a 2×2 example for the touchscreen circuit, as shown in Figure 2. Assume that we connect a voltage source V_s between the top and bottom terminals of the blue strips, and a voltmeter V_m to one of the left or right terminals as depicted in the diagram. If $V_s = 3\text{ V}$, $R_x = 2000\ \Omega$, and $R_y = 2000\ \Omega$, draw the equivalent circuit for when the point $(2, 2)$ is pressed and solve for the measured voltage, V_m , with respect to ground.
- Suppose a touch occurs at coordinates (i, j) for an arbitrary $N \times N$ touchscreen, and the voltage source and meter are connected as in the figures. A 5×5 example is shown in Figure 1(b). Find an expression

for V_m as a function of V_s , N , i , and j . Again, the upper left corner is the coordinate $(1, 1)$ and the upper right coordinate is $(N, 1)$.