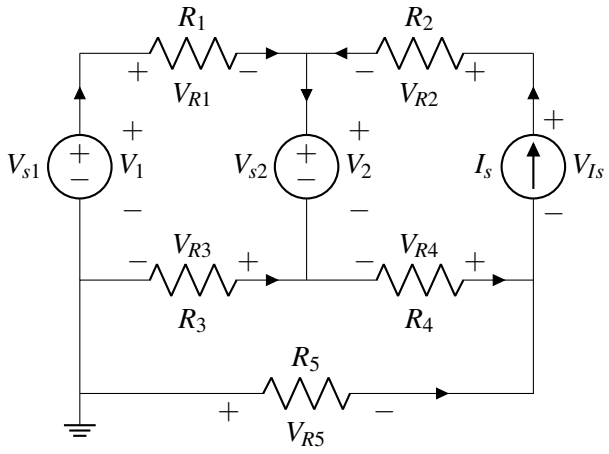
EECS 16A Designing Information Devices and Systems I
Spring 2023 Exam Prep 8B

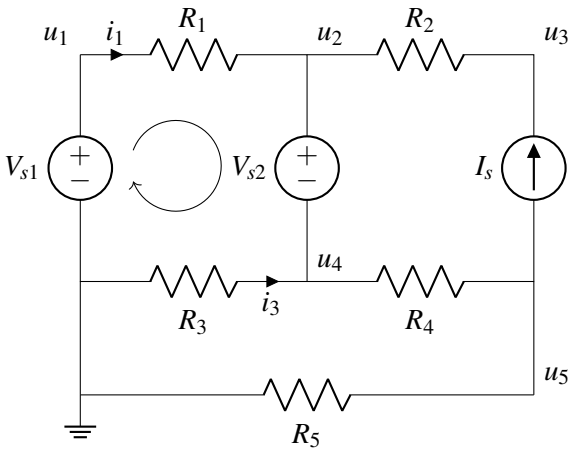
1. Circuit Analysis (Fall 2020 Midterm 2 Question 3)

(a) Which components violate passive sign convention in the circuit below? Select all that apply.

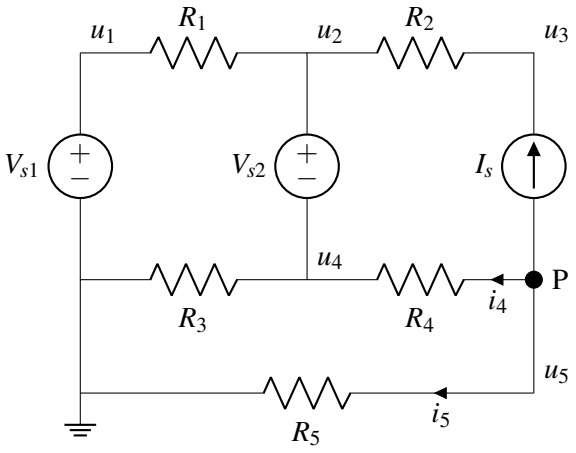


(1) R_1
(2) R_2
(3) R_3
(4) R_4
(5) R_5
(6) I_s
(7) V_{s1}
(8) V_{s2}

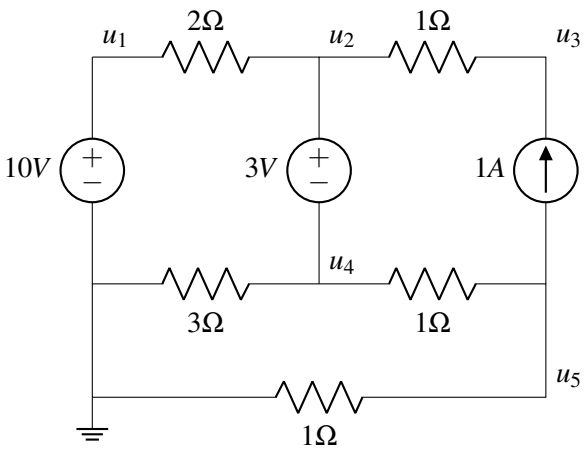
(b) Write a KVL expression for the loop drawn in the circuit below. Your answer should be in terms of u_1, u_2, u_3, u_4, or u_5 and V_{s1} and V_{s2}. Please do not add labels to the figure.



(c) Write the expression for KCL at node P in terms of currents I_s, i_4, and i_5 as labelled in the circuit below. Then, re-write the expression in terms of I_s, node voltages, and resistances only. The rewritten expression should not contain i_4, and i_5. Note that P is a label for a node, not a node voltage value.



(d) Given the node voltage $u_4 = 3\text{V}$ in the circuit below, find the node voltage u_2. Justify your answer. *Hint: You should not have to do many calculations for this part.*



(e) How would you connect an ammeter to the circuit above to measure the current flowing through the 3Ω resistor? Redraw the full circuit schematic from with the ammeter connected correctly.

2. Resistive Touchscreens (Fall 2020 Midterm 2 Question 6)

We have an H-shaped grid of resistors as shown in Fig. 1 that we would like to use as a touchscreen. Points P_{00}, P_{10}, P_{01}, P_{11}, P_{02}, and P_{12} are depicted by the black dots. Throughout this question, **measuring a voltage at a certain point means connecting the + terminal of a voltmeter to the black dot corresponding to that point and the − terminal of the voltmeter to the ground node. Note that all resistors are 1kΩ.**

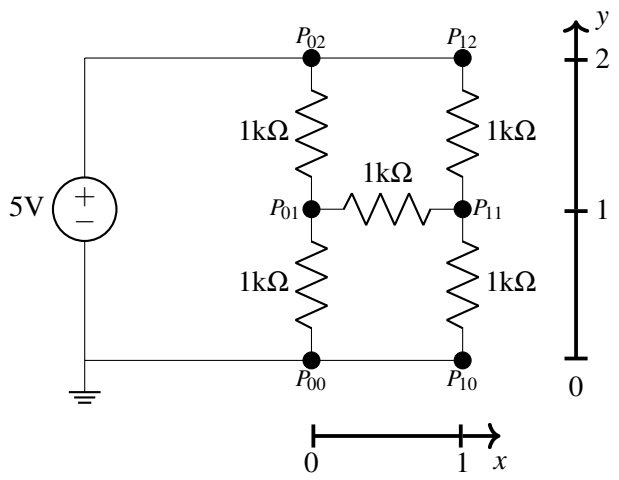


Figure 1: A schematic of the H-shaped resistive touchscreen.

(a) What are the voltages measured at each of the 6 points P_{00}, P_{10}, P_{01}, P_{11}, P_{02}, and P_{12} in Fig. 1?

(b) Can we determine the horizontal position (x-coordinate) of touch using this touchscreen in Fig. 1? Can we determine the vertical position (y-coordinate) of touch using this touchscreen? For each direction, if you can, explain why. If you cannot, explain why not.

(c) Your friend at Stanford proposes using a different resistive touchscreen shown in Fig. 2. Note that there is a mix of 1kΩ and 2kΩ resistors, and they accidentally connected a wire between P_{11} and P_{10}.

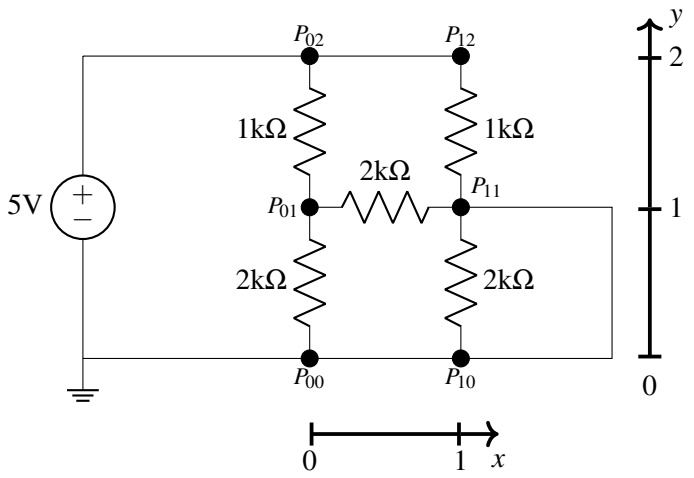


Figure 2: A touchscreen proposed by your Stanford friend for part (c).

(i) Your friend claims to measure a voltage of 0V. Can you identify where the touch happened? If a point exists, write it. If multiple points exist, list them. If no points exist, say so. Explain your answer. Note that the measurement circuit is not shown in the figure.

(ii) Then your friend claims to measure a voltage of 2.5V. Can you identify where the touch happened? If a point exists, write it. If multiple points exist, list them. If no points exist, say so. Explain your answer. Note that the measurement circuit is not shown in the figure.

(d) You are now given the resistor grid shown in Fig. 3. Your goal is to uniquely determine the horizontal position (x-coordinate) of a touch. How would you connect your voltage source to do this? Redraw the full circuit with the voltage source terminals connected to the correct nodes.

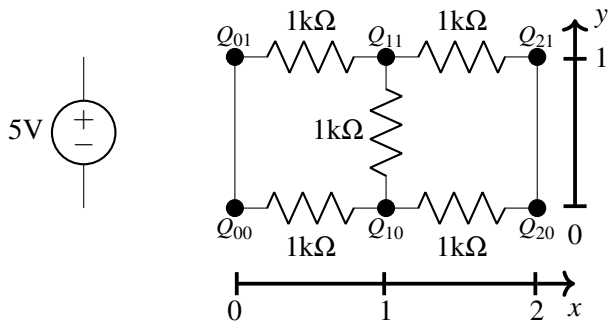


Figure 3: Resistor grid for part (d).