

# KiCad: Schematic Capture & SPICE Simulation

BME253L - Fall 2025 - Palmeri

Duke Biomedical Engineering

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## Learning Objectives

- Create a schematic in KiCad
- Annotate and assign component values
- Set up and run a SPICE simulation
- Analyze simulation results

## Voltage Divider Circuit

### Capture the Schematic

- Create a new KiCad project.
- Fill in the schematic metadata that is populated in the right foot of the sheet.
- Create the circuit shown below using the schematic editor. Note that all of the sources chosen are SPICE DC sources.

V1 is a simulation DC voltage source. It doesn't have to be a simulation source unless you plan to sweep its value.

\* Inspect -> Simulator  
\* DC Sweep Analysis  
\* Sweep R2

R2 has an "Ideal" resistor simulation model associated with it in its Simulation Model properties.

DC - DC Sweep Analysis

| Source | Start | Stop  | Step |
|--------|-------|-------|------|
| R2     | 0.1   | 10000 | 100  |

Simulation Model Editor

Model: R (Resistor)

Device: Resistor

Value: 1k

Simulation Model Properties

| Property    | Value |
|-------------|-------|
| Resistance  | 1k    |
| Temperature | 27    |
| Material    | Gold  |

Voltage Divider - Plot Sweeper

Plot: Power (mW)

Y-axis: Power (mW)

X-axis: Resistance (ohm)

Legend: Power (mW)

Simulation Results

| Resistance (ohm) | Power (mW) |
|------------------|------------|
| 0.1              | 0.000      |
| 100              | 0.000      |
| 1000             | 0.000      |
| 10000            | 0.000      |

MedTech Prototyping Skills (BME254L)  
Mark Palmeri  
Duke University  
Sheet: /  
File: voltage\_divider.kicad\_sch  
Title: Voltage Divider  
Size: A4 Date: 2025-01-03 Rev: Rev1  
KiCad E.D.A. 9.0.4 Id: 1/1

Gradescope!

Upload a screenshot of your complete schematic window to Gradescope.

## Simulate Maximum Power Transfer

In a recent problem set, you analytically solved for the load resistance that maximizes power transfer in a voltage divider circuit. In this section, you will simulate the same circuit in KiCad and verify your results.

- Sweep the value of  $R_2$  (representing the load resistance) from  $0.1$  to  $10\text{k}\Omega$  in increments of  $100\Omega$ , for a fixed  $R_1$  of  $1\text{k}\Omega$  (representing the source resistance).
- Plot the power dissipated in  $R_2$  as a function of  $R_2$  and identify the value that maximizes power transfer.

### Gradescope!

Upload a screenshot of your swept resistance plot demonstrating maximum power transfer to Gradescope.

## Multi-Source Circuit

The circuit shown below was one of the problems in your recent exam.

### Capture the Schematic

- Create a new KiCad project.
- Fill in the schematic metadata that is populated in the right foot of the sheet.
- Create the circuit shown below using the schematic editor. Note that all of the sources chosen are SPICE DC sources.



 Gradescope!

Upload a screenshot of your complete schematic window to Gradescope.

### Simulate the Operating Point (OP) Analysis

- Operating Point simulations are appropriate for circuits that have DC sources and single-valued element current / voltage values.
- Run an OP simulation for this circuit and verify your results, as shown annotated in the circuit above and summarized below.

```
Note: Code1 model file loading path is /home/mlp6/Teaching/BiomedicalElectronicsMeasurements/labs/multi_source/
Note: Compatibility modes selected: ps lt a
Circuit: KiCad schematic
Doing analysis at TEMP = 27.000000 and TNOM = 27.000000
Using SPARSE 1.3 as Direct Linear Solver
Reference value : 0.00000e+00
No. of Data Rows : 1
```

Simulation results:

|                  |         |
|------------------|---------|
| I(r1):           | 1.25A   |
| I(v1):           | -1.25A  |
| I(r3):           | 750mA   |
| I(r2):           | 1.5A    |
| I(i1):           | 1A      |
| P(i1):           | -7.5W   |
| P(r2):           | 11.25W  |
| P(r3):           | 5.625W  |
| P(v1):           | -25W    |
| V(net_i1-pad2_): | 7.5V    |
| V(net_r1-pad1_): | 20V     |
| P(r1):           | 15.625W |

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Upload a screenshot of your operating point (OP) simulation results to Gradescope.

### Simulate DC Sweeps

- Perform a new analysis that sweeps several components over a range of values:
  - Sweep  $V_1$  from 1 to 10 V in increments of 0.2 V
  - Sweep  $I_1$  from 1 to 5 A in increments of 0.2 A
- Plot:
  - $I_{R_2}$

$$-P_{V_1}$$

$$-P_{I_1}$$

You should see results similar to those shown below.



**i** Gradescope!

Upload a screenshot of your DC sweep simulation results to Gradescope.