

Final Project - Capacitance meter

1 Requirements

Your circuit should be capable to measure capacitance in the range from 10 nF to 100 nF. I would suggest to use potential difference (voltage) as the output of your device, i.e. build C to V converter.

- The final product **must not use**
 - an oscilloscope;
 - a function generator;
 - a multimeter in capacitance meter settings.
- It is ok to use above items during prototyping and debugging.
- You allowed to use any other discrete components, which we studied in the class.
- The final product can use a multimeter in either voltmeter, ampermeter, or ohmmeter settings.
- The number which we read on a multimeter does not need to show capacitance, but after referring to a calibration plot or table, we should be able to deduce the capacitance.

1.1 Multisim

Feel free to use Multisim to test and confirm your derivations. However, Multisim by itself does not prove anything! We need to see the conceptual ideas and derivations.

1.2 Time frame

- You have 2 in-class lab sections (the week of 4/26 and the week of 5/3) to complete the design in hardware.
- Before 2nd week (the week of 5/3) labs begin, everyone should submit their circuit diagram to Gradescope with explanations of overall idea.
- You have extra time (the partial week of 5/10) to complete your report.

1.3 Team composition

You are allowed to work in a team of up to 3 people during brainstorming and prototyping (i.e. week of 4/26). However, everyone has to build their own hardware implementation. It is still ok to summon team's expertise in a verbal form, but nobody, but you or instructors or TAs, is allowed to touch your circuit during the second week.

1.4 Help from instructors and TAs

We **will not** give you a design of the final circuit. But it is ok to check your ideas with us. We will help you to make your circuit work (unless it is an unrealistic design), i.e., if you have a working design and it is expected to behave or perform correctly, we will help you to debug it.

1.5 Proof of work

Make sure an instructor (either Ran or Eugeni, not a TA) signed your logbook, by the end of each day of week of 4/26 and week of 5/3 before you leave the lab room.

2 Grading (this project is 30% of your total grade)

1. (20 points) pre-final week design after the first week. Due date **May 3rd 2pm**, submit to Gradescope. Instructors will provide their feedback on a feasibility of the design, before the next lab start.
2. (40 points) Working hardware prototype, which deduces capacitance within an order of magnitude from actual values.
3. Final report. Due date **May 13th 2pm**, submit to Gradescope. Keep the report concise **3 pages maximum** font size 14 pts (plus space for the circuit diagrams and logbook attachments).
 - (20 points) Description of design ideas: how it works, what basic circuits and in what regimes it is using. The final circuit diagram with components values and **explanations** of conceptual blocks. Showing relevant MultiSim simulations is a plus.
 - (10 points) Description of the test procedures and calibration data in the graphical form.
 - (10 points) If you measure 5 mystery capacitor values within 10% of their real values. The measured/deduced values should be shown in the report.
4. (5 points bonus) If you use only DC settings of the multimeter to deduce the capacitance.

Note: Make sure that you provide signed by an instructor (not a TA) logbook pages with your report, i.e. proof of work.