C-V characteristics of MOSCAP and Solar Cell

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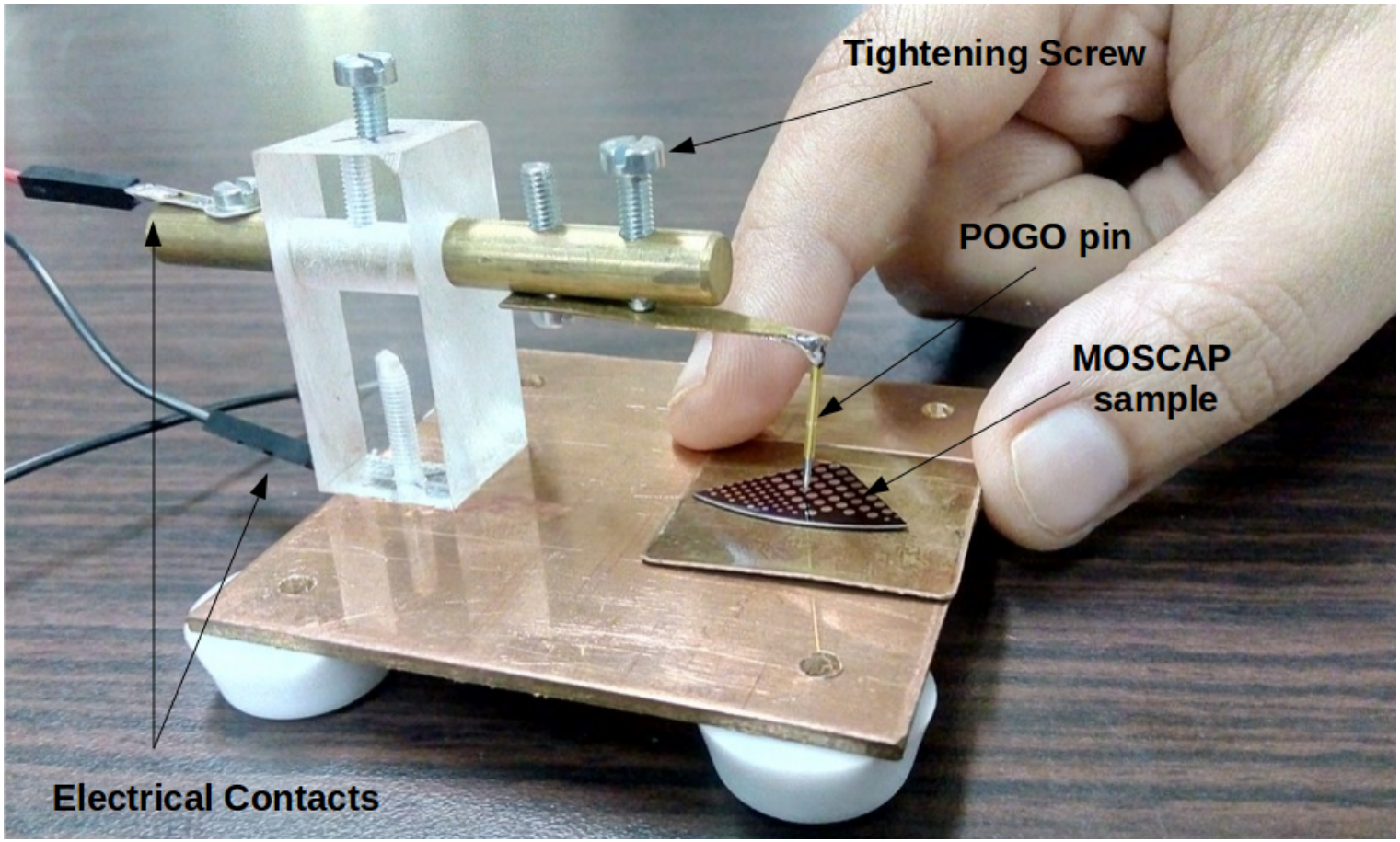
Credits

- You are the first users of this new experimental set-up.
- We are thankful to Mr.Chandrakant and Mr. Rajesh for the fabrication of 40 probe stations, and Mr. Ambika and Ms. Swasti for the fabrication of the MOSCAP samples.
- We are thankful to Jabir, Jeffin, Abhishek, Keyur, and Mukul for designing and testing of the experiment under the guidance of Prof. Arora and Prof. Narasimhan.

Part A: MOSCAP C-V measurement

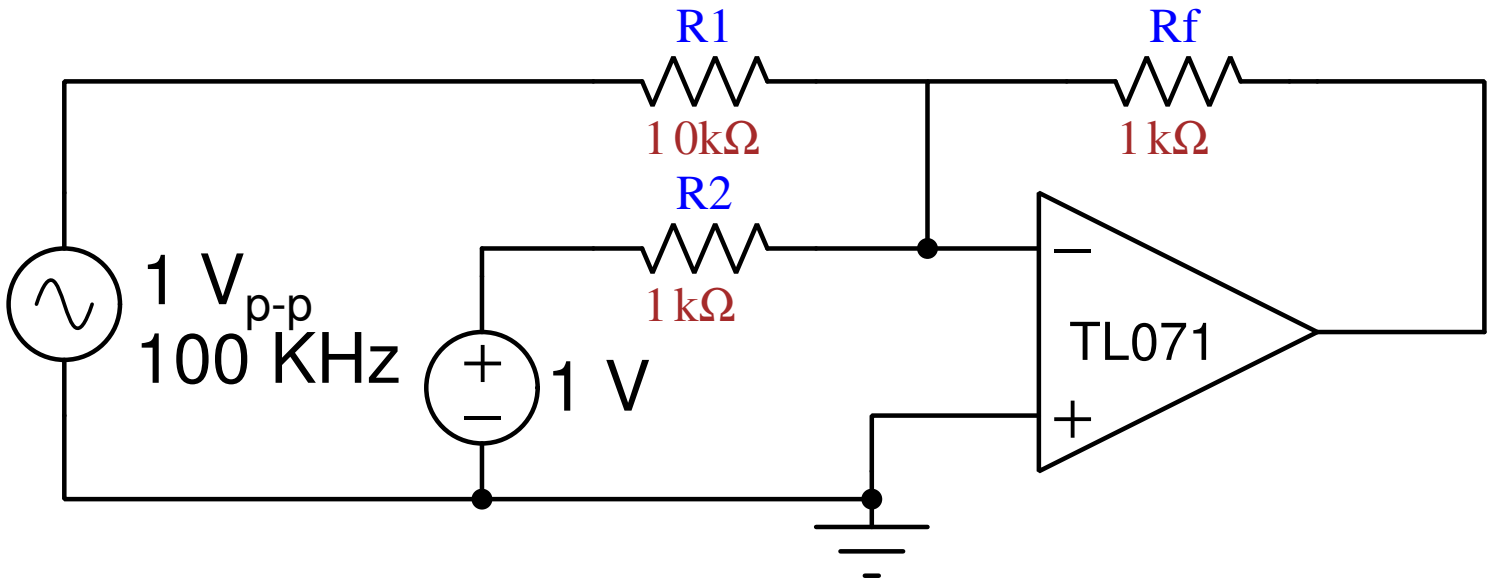
The experimental set-up



Precautions:

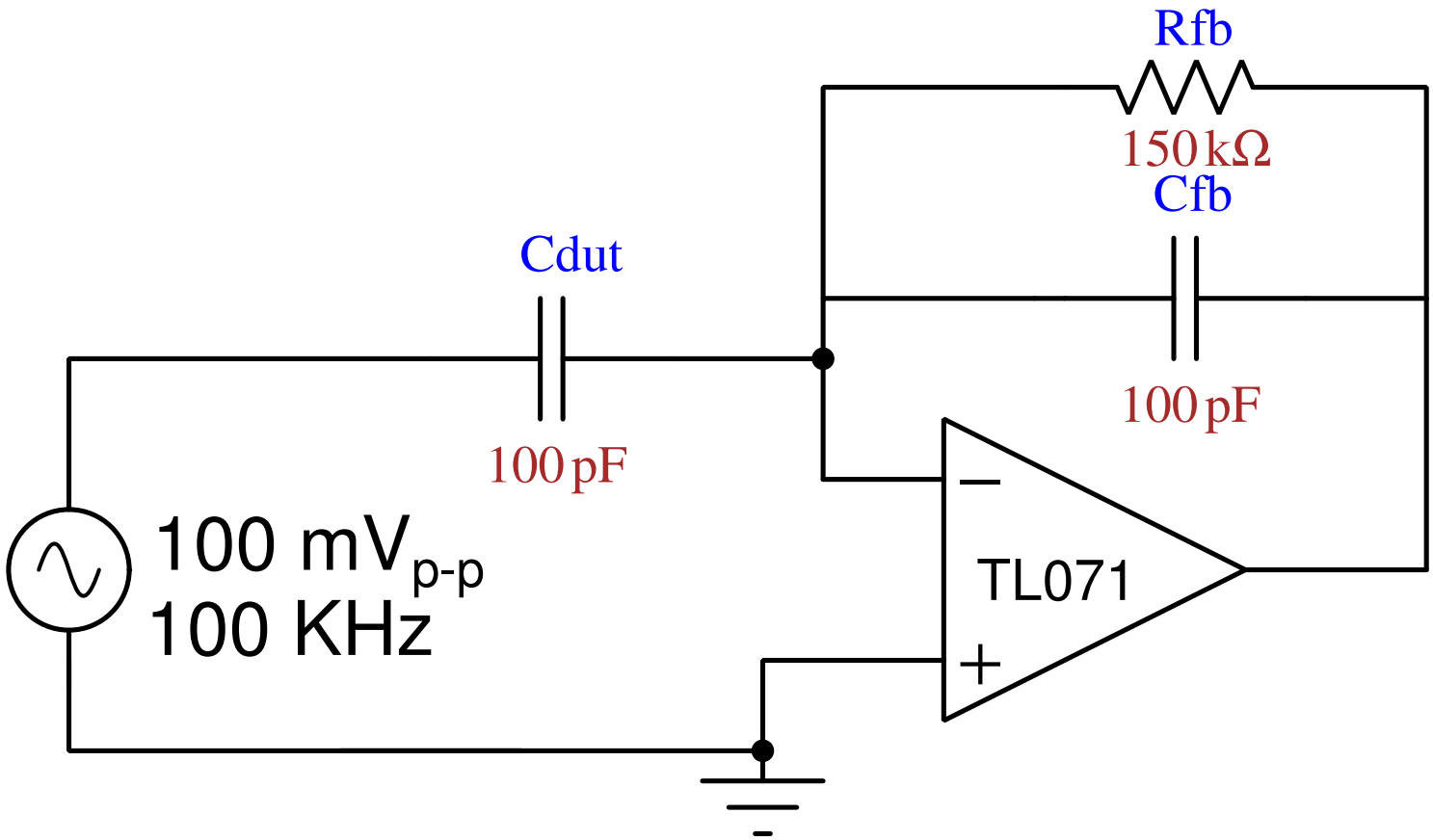
- Handle the MOSCAP sample with utmost care.
- Hold the metal plate over which MOSCAP sample is sticked. Avoid direct hand contact with the MOSCAP sample.
- POGO pin of the set up is delicate. Do not bend/tweak more, while placing the sample under it.
- Choose a circular metalized region (well within boundaries) from the sample surface and align it right under the contact needle.
- Make sure you don't overtighten the POGO pin onto the sample causing scratches on its surface. Get the help of RA/TAs in case of any doubt.

Part I: Summer Circuit



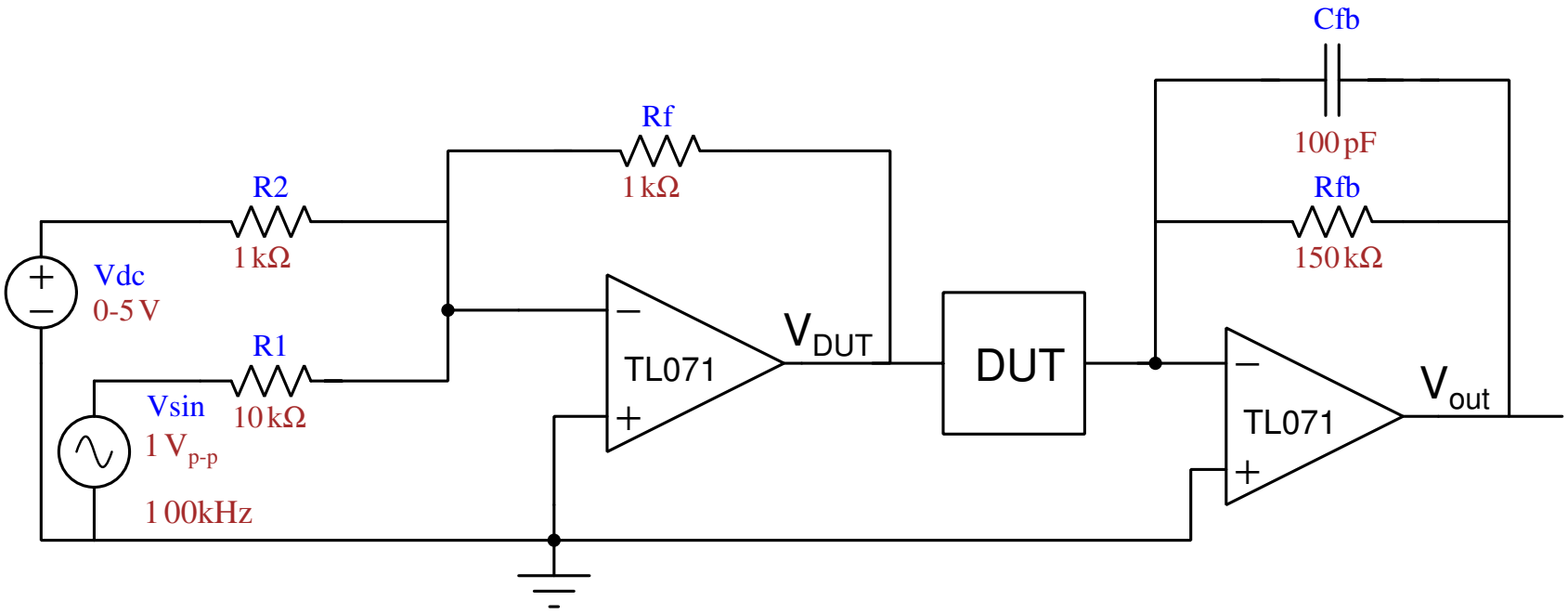
- Recall the working of the summer circuit.
- What do you expect at the output of the above circuit?

Part II: Amplifier Circuit



- Wire up the above circuit, leaving the previous circuit intact.
- What do you expect at the output of the above circuit?
- Change the value of Cdut to 330 pF. What do you see at the output?

Part III: Measurement of MOSCAP C-V characteristics



- Combine the circuit from parts I and II as shown above.
- We have to measure the capacitance of the DUT, C_{DUT} as Vdc is varied from 0 to 5 V.
- NOTE:
  - DUT refers to the MOSCAP sample you are provided with.
  - Make sure that the DC output of V_{DUT} is connected

Part III: Measurement of MOSCAP C-V characteristic

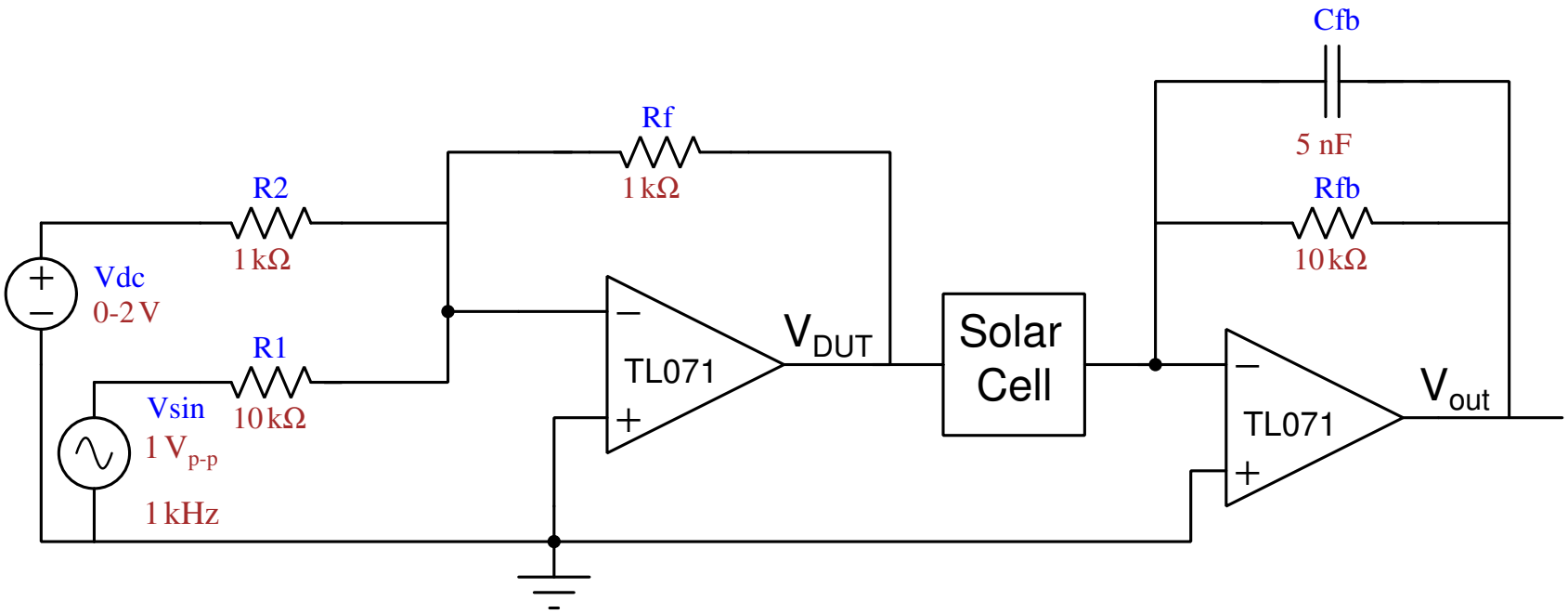
For the above circuit, the ac gain from V_{DUT} to V_{out} is given by,

$$\left|\frac{V_{out}}{V_{DUT}}\right| = \frac{C_{DUT}}{Cfb}\frac{1}{\sqrt{1+\frac{1}{\left(\omega RfbCfb\right)^2}}}$$

- Set Vdc to 0 V. From the observed value of the gain, find C_{DUT}.
- Vary the dc voltage in steps while tabulating the C_{DUT} and the applied DC voltage.
- Plot C_{DUT} vs Vdc and obtain the following:
  - Oxide capacitance (diameter of the dot is 1 mm).
  - Oxide thickness.
  - Flat band voltage.
  - Flat band capacitance.

Part B: Solar Cell C-V measurement

In this part of the experiment, you will measure the C-V characteristics of the Solar Cell provided to you. The experimental setup uses the same circuit but with different parameters and DUT is replaced by Solar Cell. Connect Solar Cell such that it should be reversed bias.:



Measurement of Solar Cell C-V characteristic

Obtained Capacitance of Solar Cell C_s using the same formula given in slide no 8.

- Vary the dc voltage in steps from 0 volt to 2 volt while tabulating the C_s and the applied DC voltage.
- Plot $\frac{1}{C_s^2}$ vs V_{dc} and obtain the following:
  - Doping Density
  - Build in Voltage