Indian Institute of Technology, Bombay
Department of Electrical Engineering
Electronic Devices Lab(EE-236)
Mid-Sem Exam Part 2, Date: March 02, 2022

Timing: 3:10 PM to 4:10 PM | Spring 2022 | Max marks: 10

1 Instructions

- You are allowed to use only those models that have been provided. You can download by clicking the name.
- You need not edit any model file.
- You can use previous lab report and netlist only.

2 Problem Statements

1. You have been given a PIN diode − RN142S. PIN diode has a wide, undoped intrinsic semiconductor region between P and N regions. The p-type and n-type regions are heavily doped. In this question you will understand, how this 'I' region makes PIN diode different from a PN diode.
   - **I−V characteristics:** Find **forward voltage**, **reverse saturation current**, **PIV** and **ideality factor** of the given diode and compare with normal PN Diode ($1N914$).
   - **Storage time:** In this part, you have to find reverse recovery time of the given PIN diode at various frequencies (say 10kHz, 100kHz, 1MHz, 10MHz), and then plot reverse recovery time vs frequency. Now, repeat the same with 1N914. Based on you observations answer the following.
     - Which diode will be a **good rectifier** at 1kHz?
     - Which diode has the potential of passing major portion of the input signal to the output at 10MHz?
   - **RF Switch:** At lower frequencies, PIN diode behaves like a PN diode. However, at RF frequency it can act as a switch depending on the dc bias.
     - Here you have to write a netlist and simulate the given RF switch circuit, see Figure 1 and plot output voltage, output current and diode current for different dc bias voltages (say, -5V, 0V, 5V).
     - Relate this circuit with **SPST** switch. Figure 2 shows the symbol of a **SPST** switch. What can you say about the current swing at the output with respect to dc bias current through diode?
     - Repeat the RF switch part after replacing RN142S with 1N914 and comment on the differences.
   - **RF Resistance:** In this particular section you have to find the relation between RF resistance(dynamic resistance) and bias current of RN142S at 10MHz. RF resistance of the diode is obtained by fixing a dc operating point and superimposing a small RF

sinusoid (0.5V peak and 10MHz) to it and then finding the ratio of peak-to-peak diode voltage to peak-to-peak diode current, see Figure 3.

- Write the netlist, simulate and tabulate the RF resistance and bias current at 10MHz. Take bias current from 0.5mA to 3mA with step size of 0.5mA.
- How is RF resistance related to bias current?
- Redo this part by replacing RN142S with 1N914. What differences did you observe?

(2 + 3 + 3 + 2 Marks)

Click on Model file names to download: 1N914, RN142S. .

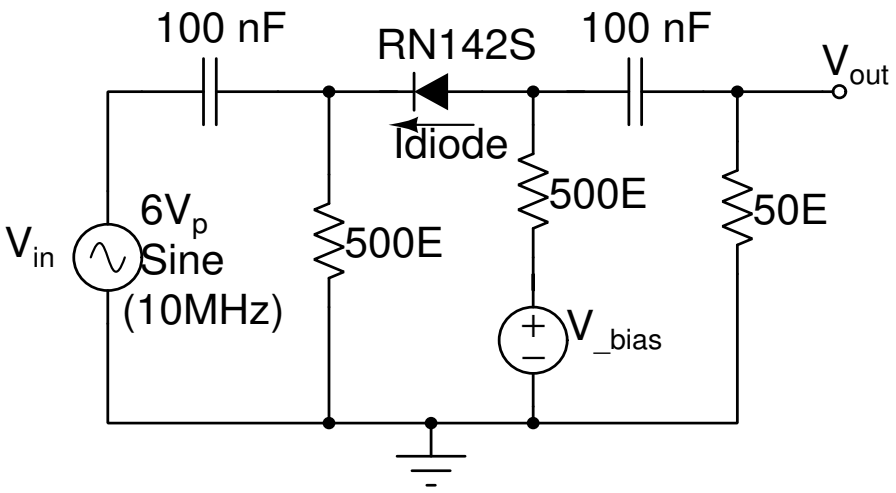

Figure 1: RF switch

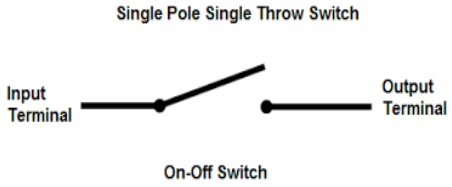

Figure 2: SPST switch

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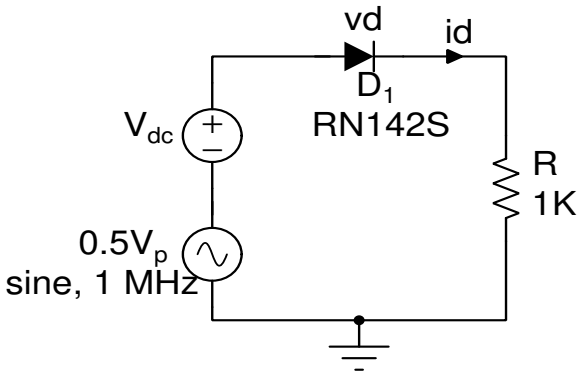

Figure 3: Circuit for finding RF resistance