Problem 1 - Terms

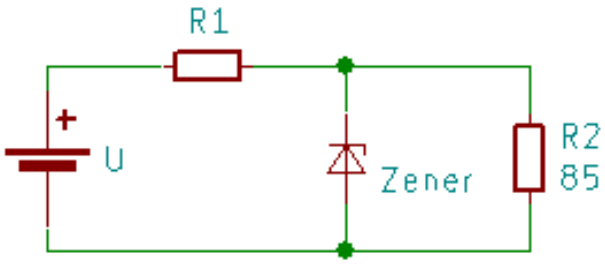
Explain the following terms. Draw the symbols for the components.

1) Diode (Diodi)
2) I-V curve (IV-käyrä)
3) Rectification (Tasasuuntaus)
4) Electric breakdown (Läpilyönti)
5) LED (Ledi, valodiodi)
6) Zener diode (Zenerdiodi)
7) Thyristor (Tyristori)
8) Photodiode (Fotodiodi)
9) Opto-isolator (Optoerotin)

Problem 2 - Zener diode

(a) The following circuit is a simple voltage regulator. Find a value for resistor R1 when R2 = 85 Ω, the Zener voltage is 3.3 V and U is 5 V. A current of at least 10 mA must flow through the Zener diode.

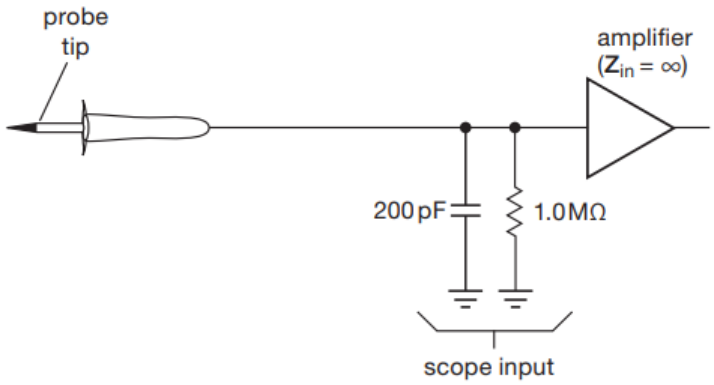
(b) Calculate the power dissipated in R2. What is the efficiency of the circuit ($\frac{P_2}{P_{total}}$)?



Problem 3 - ×10 oscilloscope probe

Design a "×10" oscilloscope probe to use with an oscilloscope whose input impedance is 1 MΩ in parallel with 200 pF. Assume that the components are placed at the tip end (rather than at the scope end) of the cable. The resultant network should have 20 dB (×10 voltage division ratio) attenuation at all frequencies, including DC.

Hint: You can think of the probe and scope input as a voltage divider.

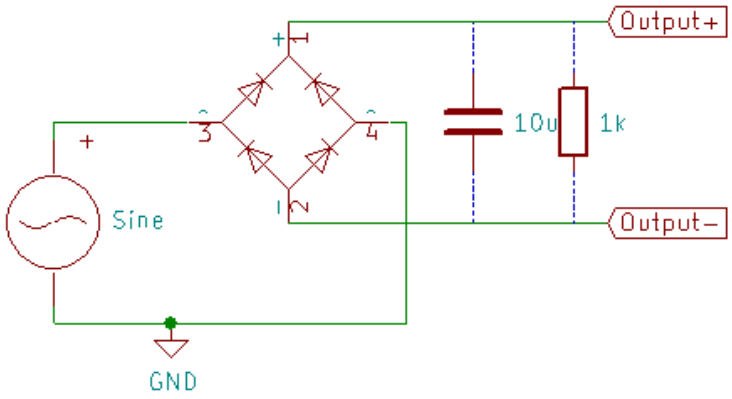


Problem 4 - Simulate a full bridge rectifier

Simulate a full bridge rectifier in LTspice. Use a 5 V_{pp} (volts peak-to-peak), 50 Hz sine wave as the input. Look at the voltage between outputs 1 (+) and 2 (-). What happens during the positive and negative cycles? First, simulate the circuit without the load or the capacitor.

Add a capacitor between the outputs. Why is this useful?

Add a load to the output. What happened to the output? What is the ripple voltage?



These tasks are done at the exercise sessions using the following equipment.

- Device: ADALM2000, a signal generator / oscilloscope combo device (link).
- Software: Scopy, which is used to control ADALM2000 (link).
  A guide to use each of the Scopy instruments is on bottom of the webpage.
- Various electronics components.

The course assistants will guide you.

Please read the tutorial before the exercise session: Diode I vs. V curves

Hands on task 2.1

Measure the I-V curve with different diodes. Also try to connecting one in reverse bias.

Hands on task 2.2

Rectify a sine wave with a single diode and a capacitor. Measure the output voltage.

EXTRA Hands on task

Build a full bridge rectifier using LEDs. Drive at low frequencies for most fun.