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**Date Created**: November 27, 2012

**Subject**: Engineering

**Schedule**: 100 minutes

Learn about <http://wild-bohemian.com/electronics/flasher.html>

Learn about RC time constant: <http://www.tf.uni-kiel.de/matwis/amat/elmat_en/kap_5/basics/b5_1_1.html>



**YOUR NAMES**

**CLASS
DATE**

Consider the circuit below. Note that the capacitors are polarized (+/-).



Figure 1. Basic flashing circuit.

1. Refer to [Electronic Symbols](http://web.gps.caltech.edu/~als/IRMS/course-materials/lecture-1---electricity/circuit_symbols.pdf). What type of transistors are used in this circuit?
2. What type of capacitors are used in this circuit?
3. Identify all the pins on the transistors.
4. Build the circuit shown in Figure 1, above, using the Circuit Lab simulator. Take a **snapshot** of your circuit. You must have **your names** depicted on the circuit.
5. Use the *Time Domain* analysis to observe the signals across the two LEDs. You can use Stop Time = 40 seconds with Steps of 0.1 second. Record the voltage across LED1 and LED2 (e.g., **9-V(LED1)** ):
	1. Period LED1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. Period LED2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. Vpp LED1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	4. Vpp LED2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Based on your simulation results, explain what exactly this circuit does.
7. Change R1 and R2 to 200K . Simulate the new circuit. What happens to the measured signals across LED1 and LED2?
	1. Period LED1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. Period LED2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. Vpp LED1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	4. Vpp LED2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. The RC time constant of this circuit for LEDs is determined by

RC Time Constant (sec) = (Resistor\_Value x Capacitor\_Value)

* 1. Calculate the RC time constant.
	2. How close is this to the simulated period?
	3. What happens to the period of the signal across LEDs as the time constant increases (change R1 and R2 to 200K ohm)?
	4. What is the unit for 1/RC?

Assume you need to build the circuit as shown in figure 1, using the Proto-board. Draw all the connections in order to build the circuit shown in Figure 1. Make sure the transistors and capacitors are connected properly (capacitors are polarized!) Use the sheet provided by your instructor. Note that the transistor looks like this:

|  |
| --- |
|  |

Figure 2. Transistor

1. When you finished **drawing** the wires on the Proto-board sheet, check everything again!
2. Did you check it again?
	1. We certify that both of us checked the circuit (Your Initials): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Create a list-of-material for your circuit (what components you need for your circuit). Once you have this list, present it **along** with your Proto-board sheet to the instructor.

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| --- | --- | --- | --- |
| Reference Designator | Value (unit) | Measured/Checked | Quantity |
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Figure 3. List of materials

1. Check/measure the value of the resistors, **capacitors**, transistors, etc. and make sure they are correct.
2. Check/record these values in the table above. Note the value of the capacitor. If the capacitors have polarity make sure you connect them properly (NEGATIVE leg must be connected to the GROUND).
3. Complete building the circuit on the **Prototype board**.
4. Test the circuit using the scope. Connect the scope to LED1 and LED2. Take a **snapshot** of at least one complete cycle of the output.
5. Using the oscilloscope measure the following:
	1. Period for LED1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. Period for LED2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. Voltage Across LED1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	4. Voltage Across LED2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Show to the instructor that the LEDs are working properly. Make sure you receive an approval code from the instructor:
	1. Approval Code: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (unique code for each team)
7. Change R1-R2 values to 200K and 50K. What happens:
	1. R1-R2 = 200K 🡪 Period: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. R1-R2 = 50K 🡪 Period: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. Show to the instructor that the LEDs are working properly. Make sure you receive an approval code from the instructor:
	1. Approval Code: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (unique code for each team)
9. Measure the power dissipated on each LED.
	1. Power LED1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. Power LED2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. Measure the total power used by this circuit.
	1. Total Power: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
11. What do you think will happen is R1 is 200K and R2 is 50K? Prove your response by building the circuit.
12. What do you propose we can do with the circuit above?
13. Imagine we change the circuit to the following.
	1. What does this circuit do?
	2. What is the function of the variable resistor?
	3. What is the purpose of TR3?
	4. When LED5 is ON, what do you think will be the status od LED3?
	5. What will you use this circuit for? Christmas tree?

