

Name _____

EET 1131 Lab #13 Multivibrators

OBJECTIVES:

1. To design and test a monostable multivibrator (one-shot) using a 555 IC.
2. To analyze and test an astable multivibrator (oscillator) using a 555 IC.
3. To use Multisim to study the effect of varying component values in a multivibrator circuit.

EQUIPMENT REQUIRED:

- Safety glasses
- Integrated Circuit: 555.
- Assorted capacitors and resistors
- Digital-Analog Trainer
- Digital Storage Oscilloscope with printing capability
- Multisim simulation software

PART A. Monostable Multivibrator Using a 555

- According to your textbook or notes, what is the formula for computing the pulse width of a 555 monostable multivibrator (one-shot)?

$$t_w =$$

- Design a 555 one-shot with a **pulse width of 2.0 seconds**. Use the formula above to calculate the required component values.
 - Show your calculation below, and fill in the blanks with your component values:

$$R_A = \underline{\hspace{2cm}} \quad C = \underline{\hspace{2cm}}$$

- Continue to the **next page**, where you will draw a diagram of your design.

- In the space below use a straight-edge to draw the circuit diagram. Your diagram should look like the textbook's Figure 14-25 (a), with the following additions:
 - Each pin on the 555 should be labeled with its **name** and **pin number**.
 - Each resistor and capacitor should be labeled with its **value**.

- Build the circuit on the breadboard. You may use either a potentiometer or a combination of series/parallel resistors to get the desired resistance value.
- Connect the 555's output to an LED.
- Trigger the one-shot using the **inverted output** of one of the trainer's pulse switches. The LED should light up for about two seconds and then go dark.
- Use the oscilloscope's Channel 1 to display your trigger signal in the top half of the oscilloscope's screen, and use Channel 2 to display the 555's output in the bottom half.
- Trigger the one-shot and observe the output pulse on the scope.
- Use the oscilloscope's cursors to measure the output pulse-width. This pulse width should be within 10% of 2 seconds. If it's not within 10%, modify your resistor or capacitor values to get within 10% of 2 seconds.
- Get a printout showing the cursors and pulse-width reading. Label this printout **Lab #13 Part A**, and **turn it in** with this lab.
- In the table below, record your measured pulse width and the percentage error from the desired value of 2 seconds.

Desired Pulse Width	Measured Pulse Width	Percentage Error = (Measured - Desired) ÷ Desired × 100%
2.00 seconds		

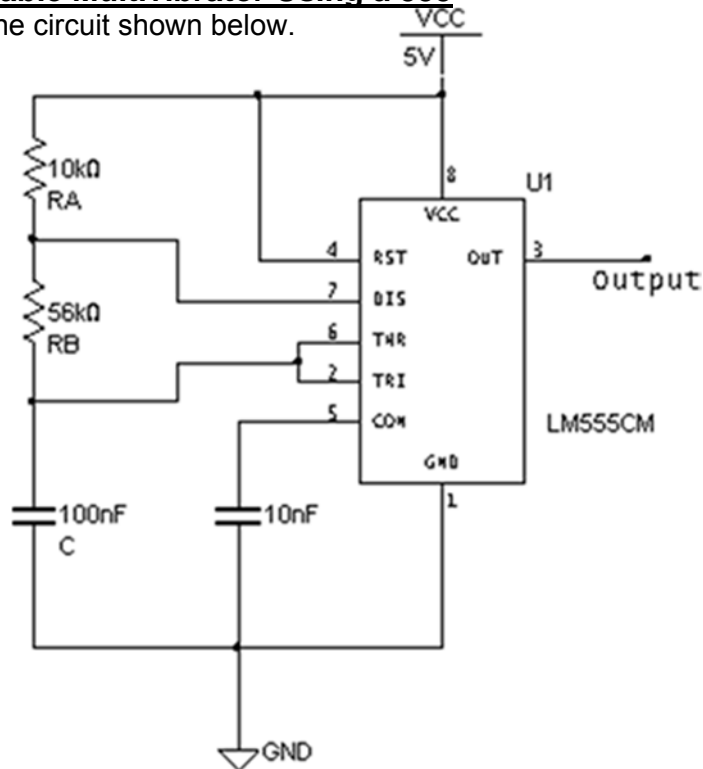
- Since you may have needed to adjust your resistor or capacitor values to get within 10%, record below the values of R_A and C that you finally used:

$R_A =$ _____ $C =$ _____

- Show me your working circuit. _____

PART B. Astable Multivibrator Using a 555

Consider the circuit shown below.



- Using equations from your textbook (as in Example 14-10), calculate values for the quantities listed in the table below. Record your calculated values, rounded to three significant digits and using engineering notation with metric prefixes.

Quantity	Calculated Value	Measured Value
Time low		
Time high		
Frequency		

- Build the circuit on the breadboard, and display the output waveform on the oscilloscope.
- Use the oscilloscope's MEASURE menus to simultaneously display the waveform's **time low (negative pulse width)**, **time high (positive pulse width)**, and **frequency**. Record these values under "Measured Value" in the table above.
- Obtain a printout showing your waveform and the three measured values. Label this printout **Lab #13 Part B**, and **turn it in** with this lab.
- Show me your working circuit. _____

PART C. The Effect of Changing Component Values

1. In Multisim, draw the circuit shown on the previous page. Display the circuit's output waveform on Multisim's Tektronix oscilloscope, which is almost identical to the real oscilloscopes we have in our lab room. Using Multisim's oscilloscope, measure the first four values listed below, and record your measured values. Also compute the duty cycle (expressed as a percentage) using this formula:

$$Duty\ cycle = \frac{t_{HI}}{t_{HI} + t_{LO}} \times 100\%$$

DATA TABLE A: Circuit with $R_A = 10\text{ k}\Omega$, $R_B = 56\text{ k}\Omega$, and $C = 100\text{ nF}$

Quantity	Multisim Value
Time low	
Time high	
Frequency	
Period	
Duty cycle	

2. Change R_B to $22\text{ k}\Omega$, and repeat Steps 1 and 2 above, recording your values in Data Table B.

DATA TABLE B: Circuit with $R_A = 10\text{ k}\Omega$, $R_B = 22\text{ k}\Omega$, and $C = 100\text{ nF}$

Quantity	Multisim Value
Time low	
Time high	
Frequency	
Period	
Duty cycle	

3. Change R_B back to $56\text{ k}\Omega$, and change $C = 10\text{ nF}$. Repeat Steps 1 and 2, recording your values in Data Table C.

DATA TABLE C: Circuit with $R_A = 10\text{ k}\Omega$, $R_B = 56\text{ k}\Omega$, and $C = 10\text{ nF}$

Quantity	Multisim Value
Time low	
Time high	
Frequency	
Period	
Duty cycle	

Questions:

1. Compare the Multisim values in Data Table A to the values that you calculated by hand for this same circuit.

2. Comparing Data Table A to Data Table B, what effect does reducing resistor R_B 's value have on the circuit's frequency, period, and duty cycle? (For each one of these quantities, say whether it **increases**, **decreases**, or **stays the same**.)

3. Comparing Data Table A to Data Table C, what effect does reducing capacitor C 's value have on the circuit's frequency, period, and duty cycle?