Student Name: ____________________ Student #:____________________

Experiment (The Ripple Counter)

AIM:
To investigate the operation a ripple counter.

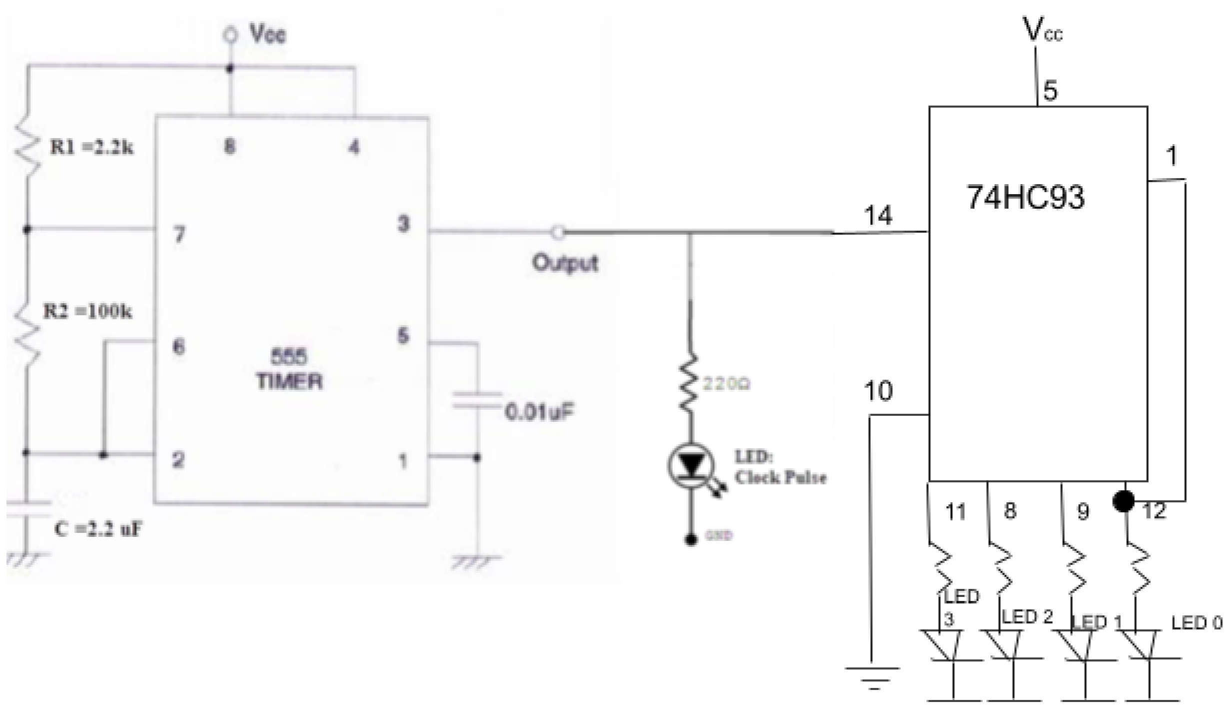
So far we have studied several types of flip-flops. One of the most flexible types of flip-flops is the J-K flip-flop. The J-K flip-flop is a very flexible device which can be used to build complex digital circuits. One such application of J-K flip-flops is to build digital counter circuits. In general, there are two types of digital counter circuits, the asynchronous counter and the synchronous counter. The asynchronous counter or "Ripple" counter is one in which, due to its design, all of the internal flip-flops do not trigger exactly in step with the clock pulse. Th

In this lab, we will study the 4-Bit Binary Counter (74HC93) - also known as a 4-bit ripple counter.

PRE-LAB WORK:
From the Digital Electronics textbook, read the attachment to this Google Classroom post.

MATERIALS:
1. 1 x 2.2 μF Capacitor
2. 1 x 0.01 μF Capacitor (103M)
3. 5 x 220 ohm resistor
4. 1 x 2.2k ohm resistor
5. 1 x 100k ohm resistor
6. 1 x – 4-Bit Binary Counter (74HC93)
7. 1x LM555CN - LM555 Single Timer IC
8. 5 x LEDs (Light Emitting Diode)

CIRCUIT:



PROCEDURE:

1. Using the circuit from your Lab #6 (555 timer), assemble the circuit above on the breadboard.
2. The Clock Pulse LED shown in the drawing is used to visually observe the clock pulse generated from the 555 timer.
3. Be sure to assemble LEDs 0 to 3 on the breadboard in the order shown in the circuit above (starting from LED0 on the right, and over to LED3 on the left).
4. Follow the schematic above and be sure to use 5 volts as the Vcc.
5. Take the binary pattern recorded on LEDs 0 to 3 in step 7 and convert to a decimal number and record in the Observations Table below.

OBSERVATIONS TABLE:

LM555 IC Clock Pulse		LED 3 (QD)	LED 2 (QC)	LED 1 (QB)	LED 0 (QA)	Decimal Equivalent
	1	0	0	0	0	0
	2	0	0	0	1	1
	3	0	0	1	0	2
	4	0	0	1	1	3
	5	0	1	0	0	4
	6	0	1	0	1	5
	7	0	1	1	0	6
	8	0	1	1	1	7
	9	1	0	0	0	8
	10	1	0	0	1	9
	11	1	0	1	0	10
	12	1	0	1	1	11
	13	1	1	0	0	12
	14	1	1	0	1	13
	15	1	1	1	0	14
	16	1	1	1	1	15
	17	0	0	0	0	0
	18	0	0	0	1	1
	19	0	0	1	0	2
	20	0	0	1	1	3

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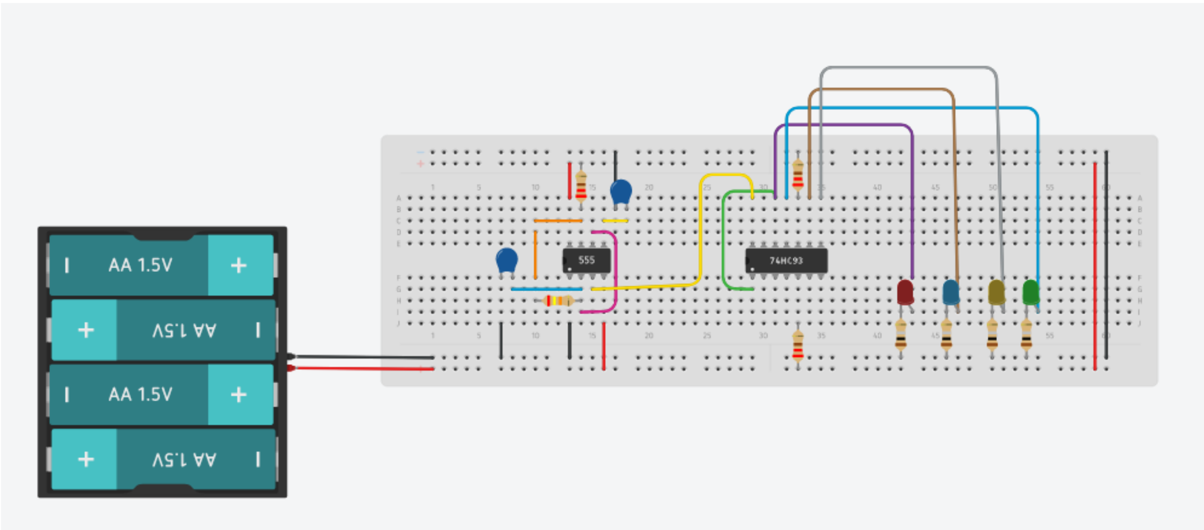
Once your circuit is working, take a snapshot of the circuit. To do this click on SHARE > Download the snapshot of your design. Paste it in the box below:



OBSERVATION QUESTIONS:

1. **After observing and recording the output binary pattern on LEDs 0 to 3 in the table above, describe what the 74HC93 IC is doing (ie. What does the changing pattern on the LEDs represent)**

The 74HC93 IC is counting up from 0 -15 in binary. Every clock pulse, the 74HC93 IC counts 1 up. In this case the LED 0 represents the least significant bit whereas LED3 represents the most significant bit.

2. **Observe the clock pulse LED. Does the count shown on LEDs 0 to 3 increment when the clock pulse goes from LOW to HI or do the LEDs increment when the clk pulse goes from HIGH to LOW?**

The count shown on LEDs 0 to 3 increment when the clock pulse goes from LOW to HIgh.

3. **Is the ripple counter chip positive edge triggered or negative edge triggered?**

The ripple chip is positive edge triggered as the count increments when the clock pulse goes from LOW to high.