# EELE 367 – Logic Design
## Lab #4 – Ripple Counters and the DE0-Nano 50MHz Clock

Lab Description

In today's lab you will design a ripple counter that is driven with the 50MHz clock on the DE0-nano board. You are going to create a D-Flip-Flop as a separate design file (dflipflop.vhd) and then instantiate it in your top level design "n" times in order to create an n-bit ripple counter. The following figure shows an example of a 4-bit ripple counter. Notice that this simple binary counter can be made completely from D-Flip-Flops without any combinational logic. Also notice that the frequency of Bit(0) will be exactly half of the incoming clock. Notice that the frequency of Bit(1) will be exactly half Bit(0), etc.
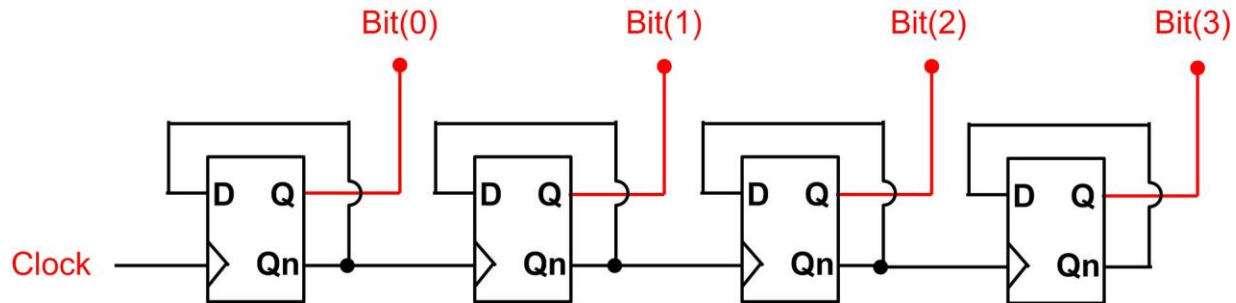
You are going to drive the character displays and red/blue LEDs on the DE0-nano IO shield using the most significant 16 bits of your n-bit counter. These bits represent the slowest moving bits in your counter. You will take these 16 bits and drive them into your four character display decoders in order to create a 4-symbol HEX counter on the displays. You will need to design the ripple counter to have enough bits in order to slow the count rate down enough so that you can visually see the count on the least significant symbol in the HEX counter. Hint: Once the count rate exceeds ~20 Hz, the human eye can't see the numbers change. You will also drive the most significant 16-bits of your ripple counter to the red and blue LEDs. Make sure to put the LSB of the 16-bits driving the character displays on LED_blue(0) and the MSB on LED_red(7) so that the 16-bits show up as a continuous binary counter on the LEDs.
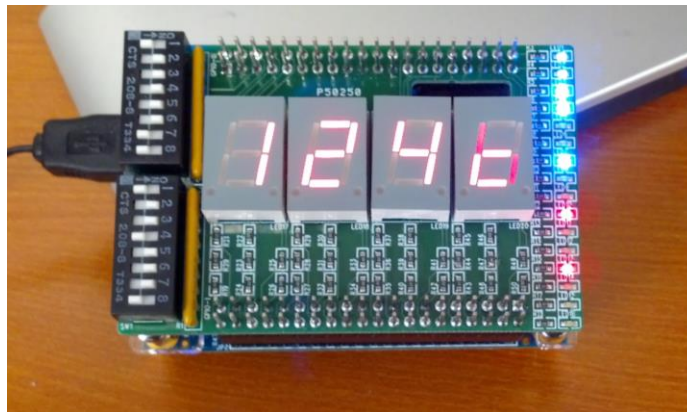
Once the counter is working, you will take a measurement with the oscilloscope of the LSB driving your LEDs and verify that its frequency is what you calculated.

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Instructor Verification Sheet

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Name(s) :   _____ / _____

Show the lab instructor the following demos:

Demo #1:   Ripple Counter
- 3 points for displaying a 4-symbol HEX counter on the character displays at a count rate that is visible to the human yet.
- 1 point for displaying the 16-bit counter on the red/blue LEDs.
- 1 point for measuring the frequency of the MSB of your 16-bit counter driving the LEDs and verifying that it matches your calculations.

Verified By: _____   Date: _____ Points: _____ / 5