Faculty of Engineering and Applied Science
Memorial University of New found land
ENGI 3861 - Digital Logic
Fall 2017

Laboratory 4:
Counters

Pre-Lab:
Each group is required to complete the pre-lab sections prior to the lab period. The pre-lab will be checked by a TA at the start of the lab. If a group's pre-lab work is not complete, student may not be allowed to complete the lab and a severe mark penalty will be applied.

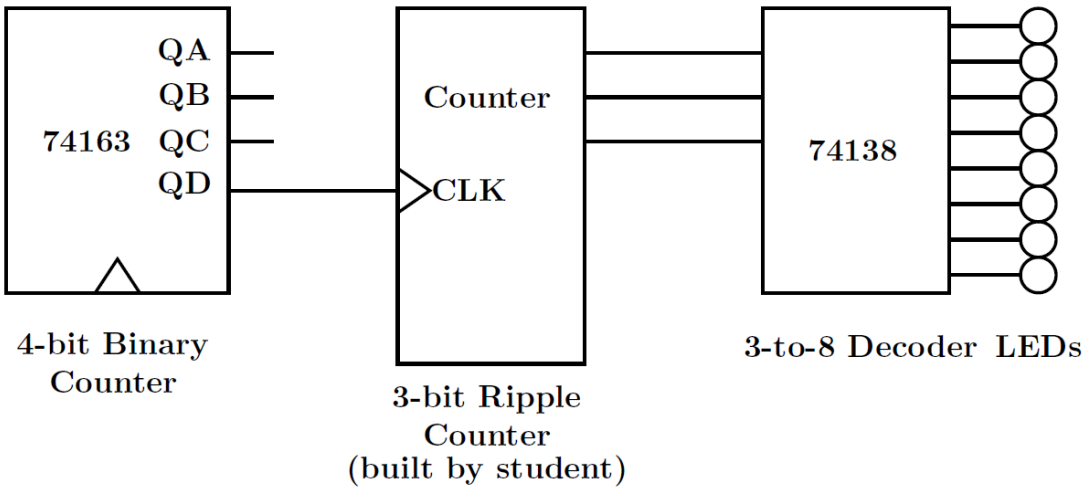
Lab Report
Each group is expected to complete a lab report. At the end of the lab, hand in the lab report, which should include the pre-lab, along with the lab observations and comments requested. Where indicated, demonstrate the correct operation of your circuit to a TA and have them sign your lab report.

1. Introduction

The purpose of this lab is to become familiar with sequential logic counters.

2. LED Sequencer

In this lab, you will be using a 4-bit counter IC, decoder, and a 3-bit counter build from D flip-flops to sequence through lighting up 8 LEDs on the digital board. The block diagram for doing this is given below.



[Prelab]

Draw the complete circuit diagram labeling the appropriate ICs and pins. The 3-bit ripple counter should be implemented using 7474 ICs which contain D flip-flops. The 4-bit binary counter and decoder should be implemented using standard MSI components, 74163 and 74138. Each output of the decoder should be connected to an LED. Explain the operation of the circuit.

[In the lab]

1) Construct and test the 3-bit ripple counter. Record the results of your testing.
2) Connect the ripple counter to the decoder and LEDs (that is, leave the 74163 device out of the circuit for the moment). Connect a push button from the logic board to the clock input of the ripple counter. Push the button to generate several clock cycles and observe the LEDs. Record the results and comment on the observed results.
3) Connect the full circuit (that is, add the 74163 into the circuit) with the clock fed to the 74163 counter coming from the function generator set to a 16 Hz square wave with appropriate levels for a CMOS digital circuit. Verify the 16 Hz clock signal by observing it on the oscilloscope and adjust the function generator, if necessary. Test the operation of the entire circuit and observe the cycling nature of the LEDs. Record your observations and comment on the resulting behaviour of the LEDs. Demonstrate your circuit to a TA and have them sign your lab report.

3. Report Submission

Submit your lab report once your circuit has been demonstrated to (and your report signed by) the TA. The lab report should include:

a) the pre-lab circuit diagram and discussion
b) recorded outcomes of tests and associated comments
c) a discussion of any problems encountered during the implementation in the lab and the methods used to overcome the problems