

ECE 380: Lab #07: Multiplexers and Decoders

In this lab, you will use the Quartus II software package to design and test combinational circuit designs with multiplexers and decoders. You will learn standard IC chips 74151, an 8-to-1 multiplexer, and 74154, a 4-to-16 decoder and use them to implement logic functions. The requirements for this lab consist of completing Quartus II designs and printing any necessary schematic diagrams, performing functional simulations, testing the designs on DE1 board, and submitting a laboratory report.

Lab procedures

Design A. Implement Design A from the prelab in Quartus II and perform functional simulations. Test all input valuations.

Download and test Design A to the DE1 board, Cyclone® V 5CSEMA5F31C6 chip.

Suggested pin assignment:

SW0 to SW2 for x,y and z

SW9 for the enable input

LEDR0 and LEDR1 for f and \bar{f} .

Based on your tests in Quartus II and with DE1, fill out the following truth table.

x	y	z	f		
			expected	Quartus II	DE1
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

Design B. Implement Design B from the prelab in Quartus II and perform functional simulations. Test all input valuations.

Download and test Design B to the DE1 board, Cyclone® V 5CSEMA5F31C6 chip.

Suggested pin assignment:

SW0 to SW3 for x0 to x3

SW8 and SW9 for two enable inputs

LEDR0 and LEDR1 for f1 and f2

Based on your tests in Quartus II and with DE1, fill out the following truth table.

N1		N2		expected		Quartus II		DE1	
x3	x2	x1	x0	f1	f0	f1	f0	f1	f0
0	0	0	0						
0	0	0	1						
0	0	1	0						
0	0	1	1						
0	1	0	0						
0	1	0	1						
0	1	1	0						
0	1	1	1						
1	0	0	0						
1	0	0	1						
1	0	1	0						
1	0	1	1						
1	1	0	0						
1	1	0	1						
1	1	1	0						
1	1	1	1						

Homework #7 (100 points)

Q1 (30 pts): Implement a 2-out-of-4 detector using the 4-to-1 multiplex. You need to draw the schematics of your design.

Q2 (20 pts): Implement the following logic function using a 2-to-1 multiplexer via Shannon's Expansion (expansion over one variable). You need to show your immediate steps.

$$f = \bar{x}_1 \oplus x_2 + \bar{x}_1 \bar{x}_3$$

Q3 (30 pts): Implementation of the following logic function

$$f(w_1, w_2, w_3) = \sum m(0, 2, 3, 4, 5, 7)$$

using a 4-to-1 multiplexer. Please use Shannon's Expansion (expansion over two variables). You need to show your immediate steps.

Q4 (20 pts): Implementation of the following logic function using 3-to-8 binary decoder and some necessary gates: $f(x, y, z) = x \oplus z + yz$.