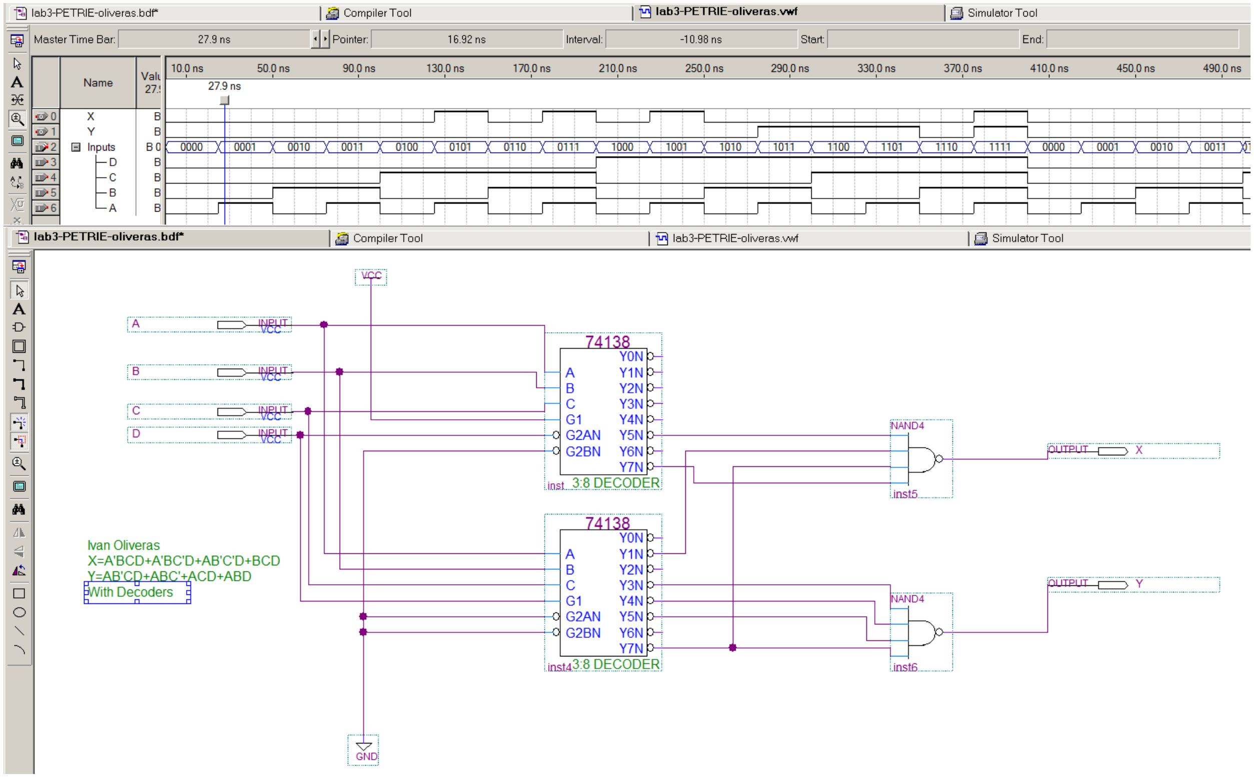
Ivan Oliveras – Lab 3

Lab 3 Quartus



Lab 3 Lab Pages

CDA3201 x Intro to Logic Design x **Lab Assignment** **3**

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3) **[Petrie-100]** Consider the following two functions:

$$X = \bar{A}BCD + \bar{A}B\bar{C}D + A\bar{B}\bar{C}D + BCD$$

$$Y = A\bar{B}CD + AB\bar{C} + ACD + ABD$$

3.1) **[Petrie – 10]** In the past we started with a Truth Table and simplified using K-maps to build a simplified circuit. In this lab we are given an equation which is not simplified, so in order to construct a K-map, you need to reverse-engineer the Truth Table or Sum of Minterms. This is equivalent to finding the Canonical Sum of Products from a Simplified Boolean Expression. There are two methods, you can either create the Truth Table or find the Minterms associated with the following products to find the Sum of Minterm equation for X and for Y. Do both methods here:

Truth Table [10]

Term Minterm#	ABCD	A'BCD	A'BC'D	AB'C'D	BCD	X
0	0000					0
1	0001					0
2	0010					0
3	0011					0
4	0100					0
5	0101		1			1
6	0110					0
7	0111	1			1	1
8	1000					0
9	1001			1		1
10	1010					0
11	1011					0
12	1100					0
13	1101					0
14	1110					0
15	1111				1	1

Term Minterm#	ABCD	AB'CD	ABC'	ACD	ABD	Y
0	0000					0
1	0001					0
2	0010					0
3	0011					0
4	0100					0
5	0101					0
6	0110					0
7	0111					0
8	1000					0
9	1001					0
10	1010					0
11	1011	1		1		1
12	1100		1			1
13	1101		1		1	1
14	1110					0
15	1111			1	1	1

Find minterms number(s) associated with each term and Sum of Minterm efor X and Y [10]

A' B C D 7

A' B C' D 5

A B' C' D 9

B C D 7, 15

X = ∑m (5, 7, 9, 15 **)**

A B' C D 11

A B C' 12, 13

A CD 11, 15

A B D 13, 15

Y = ∑m (11, 12, 13, 15 **)**

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$$X = \bar{A}BCD + \bar{A}B\bar{C}D + A\bar{B}\bar{C}D + BCD$$

$$Y = A\bar{B}CD + AB\bar{C} + ACD + ABD$$

3.2) [Petrie 10] Expand the above functions to sum of Minterm using K-maps.

We could also reverse-engineer what region each term covers using the K-maps figuring out which row(s) and which column(s) the term and putting 1s in the intersection. Underline each term (Product) in X in a different color and mark in the X K-Map in that color the 1s each term represents. Repeat for Y.

X

AB \ CD	00	01	11	10
00				
01		1	1	
11			1	
10		1		

Y

AB \ CD	00	01	11	10
00				
01				
11	1	1	1	
10			1	

To check your work, label each cell in the following K-Maps with the Minterm # of the cell, then put the 1s where indicated in the Sum of Minterms equations for X and Y done previously in 3.1.

X

AB \ CD	00	01	11	10
00	(0)	(1)	(3)	(2)
01	(4)	(5) 1	(7) 1	(6)
11	(12)	(13)	(15) 1	(14)
10	(8)	(9) 1	(11)	(10)

Y

AB \ CD	00	01	11	10
00				
01				
11	(12) 1	(13) 1	(15) 1	
10			(11) 1	

If they agree, you write the Sum of Minterms for X and Y below

X = f (A, B, C, D) = ∑m (5, 7, 9, 15)

Y = f (A, B, C, D) = ∑m (11, 12, 13, 15)

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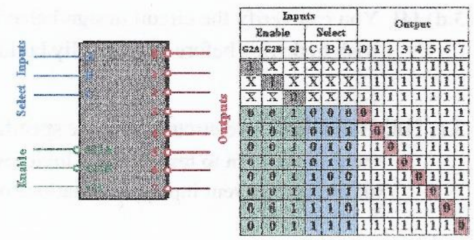
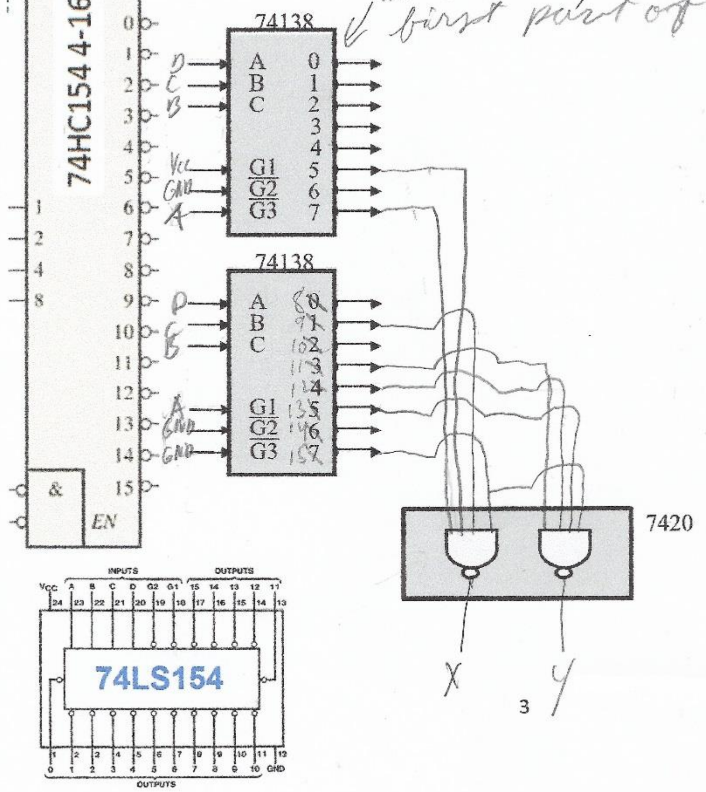


Functional Diagram of 74HC154 4 to 16 Decoder and 74138 3 to 8 Decoder

3.3) [TA-4, Petrie-30] Show the input connections necessary to realize the above Boolean expressions using exactly two 3-to-8 Decoders, (2 of 74138 chips) and two 4-input NAND gates (7420 chip). No other gates are allowed.

Active low, but that means that the first part of the OR is implemented



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3.d) [4] You can verify the circuit design/behavior by implementing the circuit using Quartus. You may wish to do this before you actually build the circuit on the breadboard.

3.e) [10] Build the above circuit using the specified logic chips on your breadboard and then connect it to the test platform to test it. Use 4 logic switches as inputs and 2 LEDs as outputs. You need to test all the 16 different input combinations of the inputs

3.3) Utilizing the same decoders with addition NANDs control the LED "B" in your 7 segment display to display for digits 0 to 9

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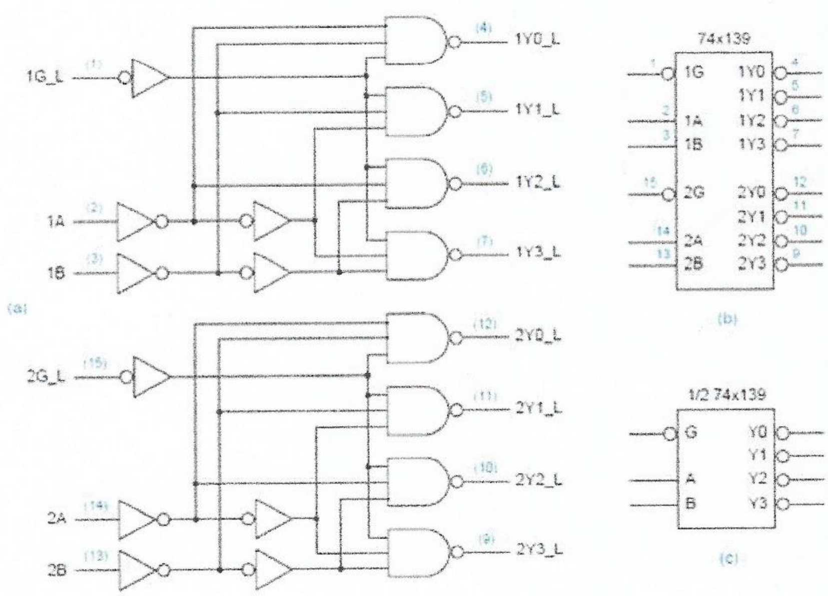

Lab 3 - Pictures