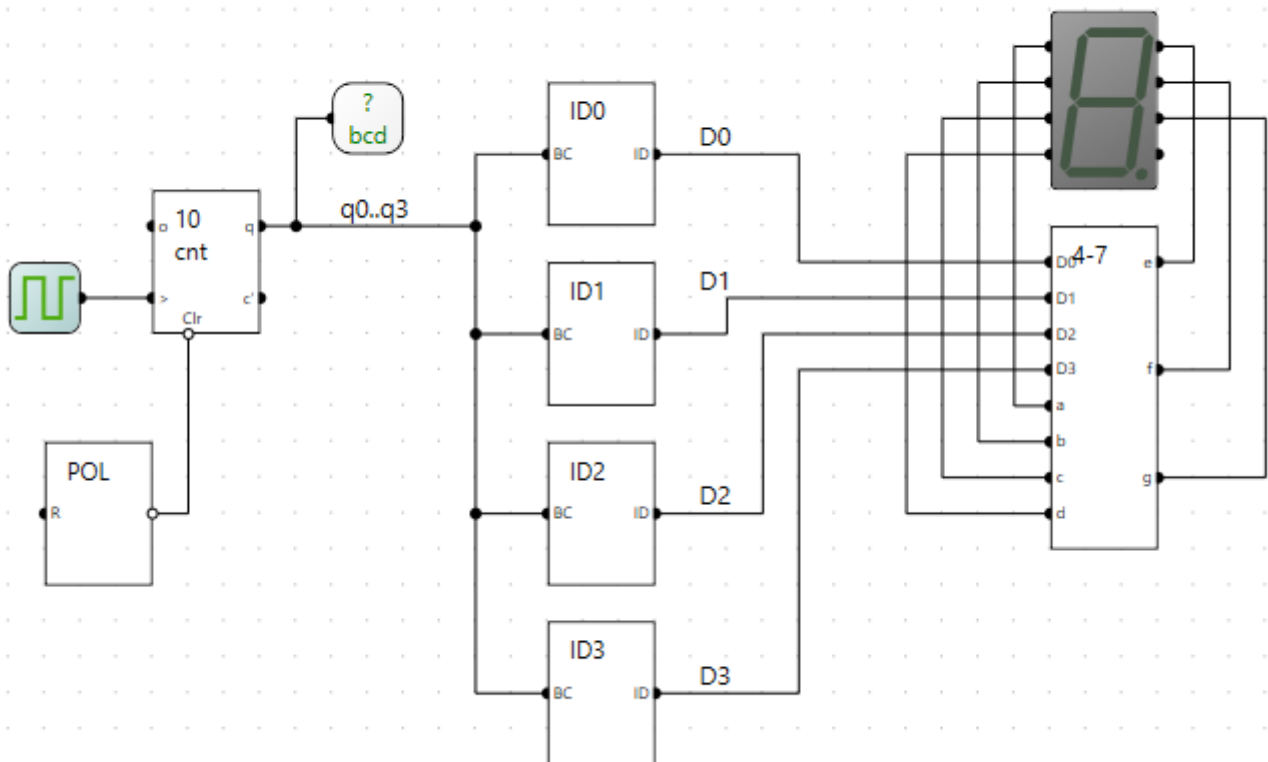


Lab Three: BCD to Red ID Converter

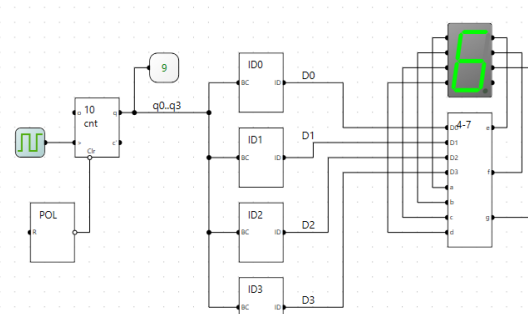
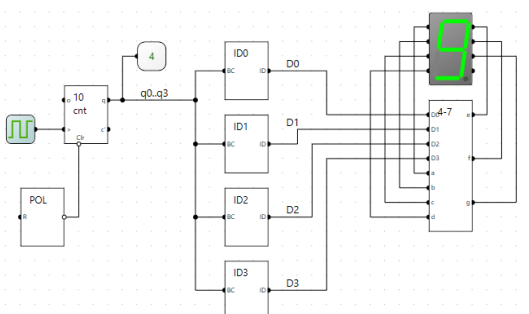
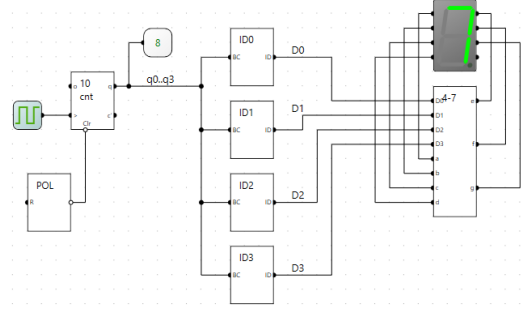
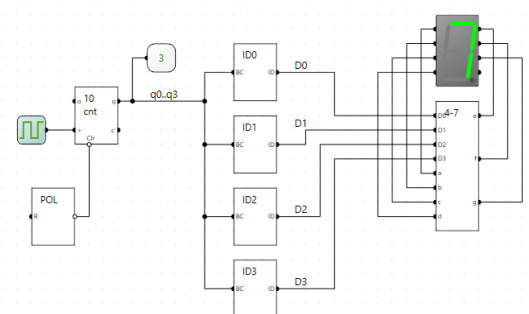
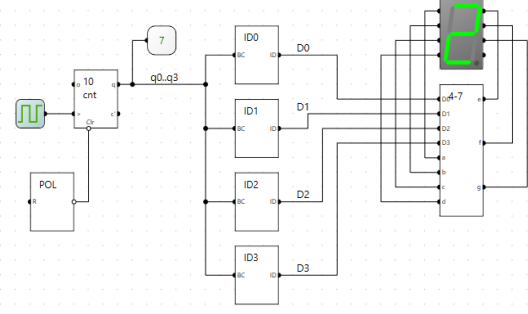
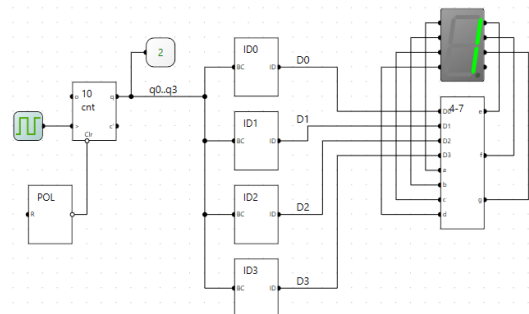
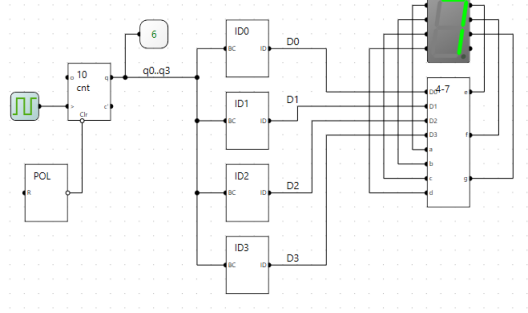
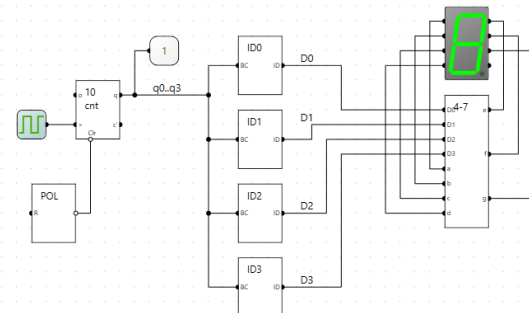
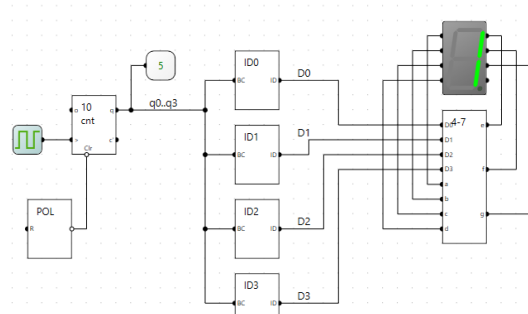
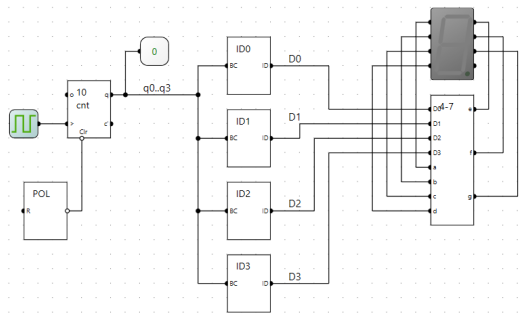
Alex Weber

Description: This lab is supposed to print my Red ID (817917276) on a seven segment display. This is done by having a clock output into a decimal counter which counts up to 10. The decimal 10 is then converted into its binary counterpart in BCD. The BCD binary counterpart is then passed into 4 circuits which convert the BCD number into the Red-ID number in BCD form. Then it is passed into a seven segment decoder which outputs into the seven segment display.

Off Schematic



Simulation:



K-Map Bit 0 Worksheet:

K-Mappings

Bit 0:

Truth-Table:

		(A)	(B)	(C)	(D)	b_0	term #
		q_0	q_1	q_2	q_3		
F	1111	0	0	0	0	1	0
8	1000	0	0	0	1	0	1
1	0001	0	0	1	0	1	2
7	0111	0	0	1	1	1	3
9	1001	0	1	0	0	1	4
1	0001	0	1	0	1	1	5
7	0111	0	1	1	0	1	6
2	0010	0	1	1	1	0	7
7	0111	1	0	0	0	1	8
6	0110	1	0	0	1	0	9
X	—	1	0	1	0	X	10
X	—	1	0	1	1	X	11
X	—	1	1	0	0	X	12
X	—	1	1	0	1	X	13
X	—	1	1	1	0	X	14
X	—	1	1	1	1	X	15

K-Map Bit 0:

$q_0 q_1$		$q_2 q_3$			
		00	01	11	10
00		1 ₀	0 ₁	1 ₃	1 ₂
01		1 ₄	1 ₅	0 ₇	1 ₆
11		X ₁₂	X ₁₃	X ₁₅	X ₁₄
10		1 ₈	0 ₉	X ₁₁	X ₁₀

$\bar{q}_1 q_2$

$q_1 q_2$

$\bar{q}_1 q_3$

SOP: $b_0 = \bar{q}_1 q_2 + q_1 \bar{q}_2 + \bar{q}_1 q_3$

K-Map Bit 1 Worksheet:

K-Mappings Bit 1:

Truth Table:	q_0	q_1	q_2	q_3	b_1	term #
0 1111	0	0	0	0	1	0
8 1000	0	0	0	1	0	1
1 0001	0	0	1	0	0	2
7 0111	0	0	1	1	1	3
4 1001	0	1	0	0	0	4
1 0001	0	1	0	1	0	5
7 0111	0	1	1	0	1	6
2 0010	0	1	1	1	1	7
7 0111	1	0	0	0	1	8
6 0110	1	0	0	1	1	9
---	1	0	1	0	X	10
---	1	0	1	1	X	11
---	1	1	0	0	X	12
---	1	1	0	1	X	13
---	1	1	1	0	X	14
---	1	1	1	1	X	15

$q_0 q_1$	$q_2 q_3$ 00	01	11	10
00	1 ₀	0 ₁	1 ₃	0 ₂
01	0 ₄	0 ₅	1 ₇	1 ₆
11	X ₁₂	X ₁₃	X ₁₄	X ₁₅
10	1 ₈	1 ₉	X ₁₁	X ₁₀

q_0
 q_1, q_2
 q_2, q_3
 $\bar{q}_1, \bar{q}_2, \bar{q}_3$

SOP: $b_1 = q_0 + q_1 q_2 + q_2 q_3 + \bar{q}_1 \bar{q}_2 \bar{q}_3$

K-Map Bit 2 Worksheet:

K-Mappings

Bit 2:

Truth Table :

		q_0	q_1	q_2	q_3	b_2	term #
F	1111	0	0	0	0	1	0
8	1000	0	0	0	1	0	1
1	0001	0	0	1	0	0	2
7	0111	0	0	1	1	1	3
9	1001	0	1	0	0	0	4
1	0001	0	1	0	1	0	5
7	0111	0	1	1	0	1	6
2	0010	0	1	1	1	0	7
7	0111	1	0	0	0	1	8
6	0110	1	0	0	1	1	9
x	_____	1	0	1	0	xx	10
x	_____	1	0	1	1	xx	11
x	_____	1	1	0	0	xx	12
x	_____	1	1	0	1	xx	13
x	_____	1	1	1	0	xx	14
x	_____	1	1	1	1	xx	15

		$q_2 q_3$			
		00	01	11	10
$q_0 q_1$	00	1	0	0	0
	01	0	0	0	1
	11	x	x	x	x
	10	1	1	x	x

SOP:

$$b_2 = q_0 + \bar{q}_1 \bar{q}_2 \bar{q}_3 + \bar{q}_1 q_2 q_3 + q_1 q_2 \bar{q}_3$$

K-Map Bit 3 Worksheet:

K-Map Bit 3:

Truth Table:	a_0	a_1	a_2	a_3	b_3	Term #
F 1 1 1 1	0	0	0	0	1	0
8 1 0 0 0	0	0	0	1	1	1
1 0 0 0 1	0	0	1	0	0	2
7 0 1 1 1	0	0	1	1	0	3
9 1 0 0 1	0	1	0	0	1	4
1 0 0 0 1	0	1	0	1	0	5
7 0 1 1 1	0	1	1	0	0	6
2 0 0 1 0	0	1	1	1	0	7
7 0 1 1 1	1	0	0	0	0	8
6 0 1 1 0	1	0	0	1	0	9
X X ———	1	0	1	0	X	10
X X ———	1	0	1	1	X	11
X X ———	1	1	0	0	X	12
X X ———	1	1	0	1	X	13
X X ———	1	1	1	0	X	14
X X ———	1	1	1	1	X	15

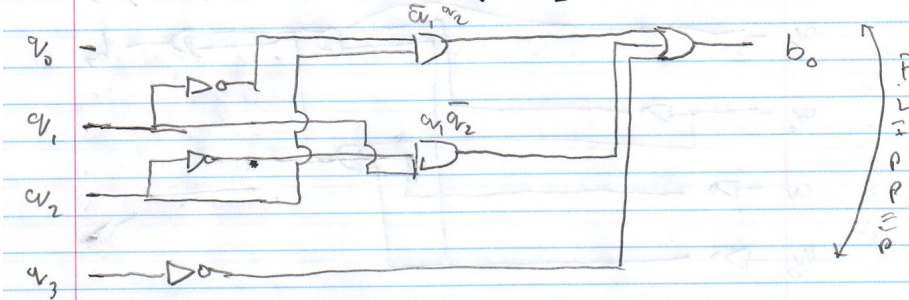
$a_0 a_1$	$a_2 a_3$	00	01	11	10
00	1	1	0	0	0
01	1	0	0	0	0
11	X	X	X	X	X
10	0	0	0	X	X

$$\overline{a_0} \overline{a_1} \overline{a_2} + \overline{a_0} \overline{a_2} \overline{a_3}$$

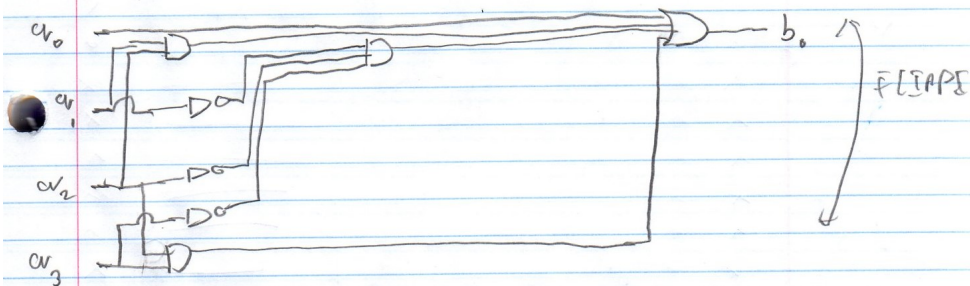
$$\text{SOP: } B_3 = \overline{a_0} \overline{a_1} \overline{a_2} + \overline{a_0} \overline{a_2} \overline{a_3}$$

Written Circuit Designs

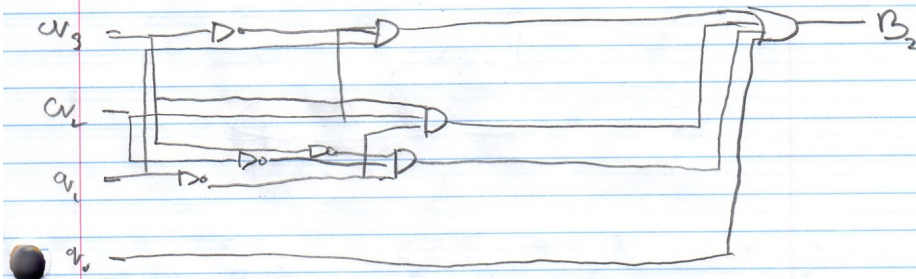
Circuit Design: $B_0 (\bar{a}_1 a_2 + a_1 \bar{a}_2 + \bar{a}_3)$



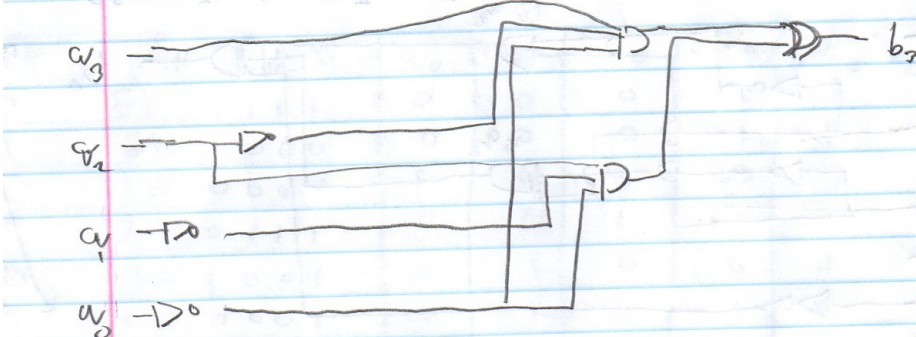
Circuit Design: $B_1 (a_0 + a_1 a_2 + a_2 a_3 + \bar{a}_1 \bar{a}_2 \bar{a}_3)$



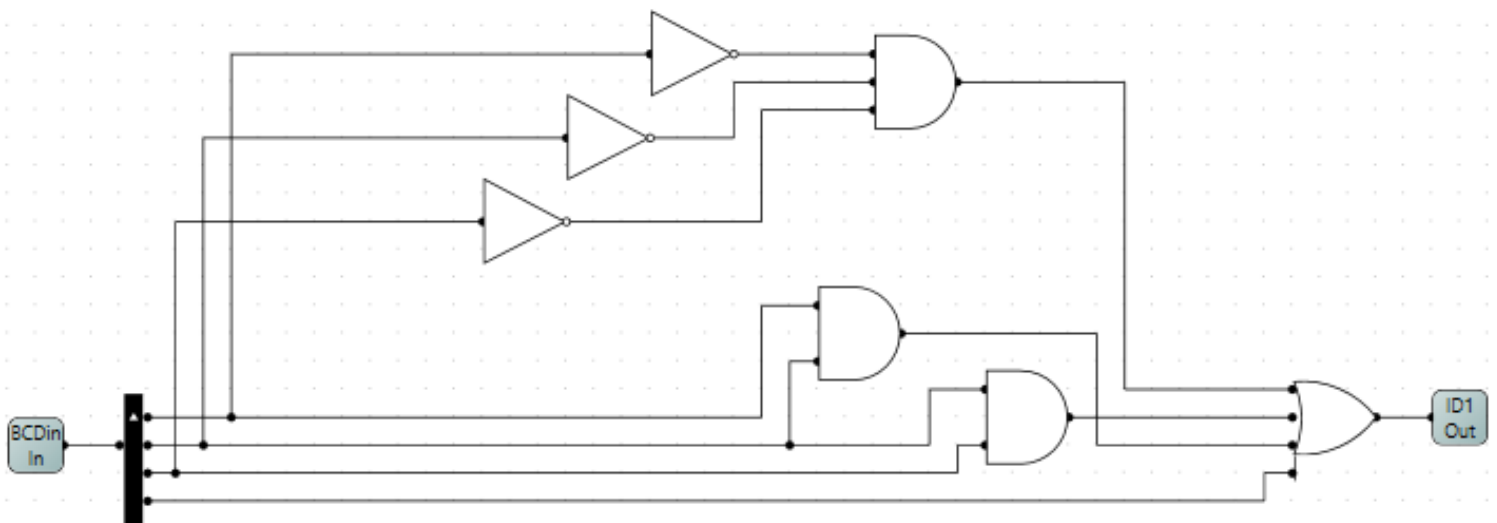
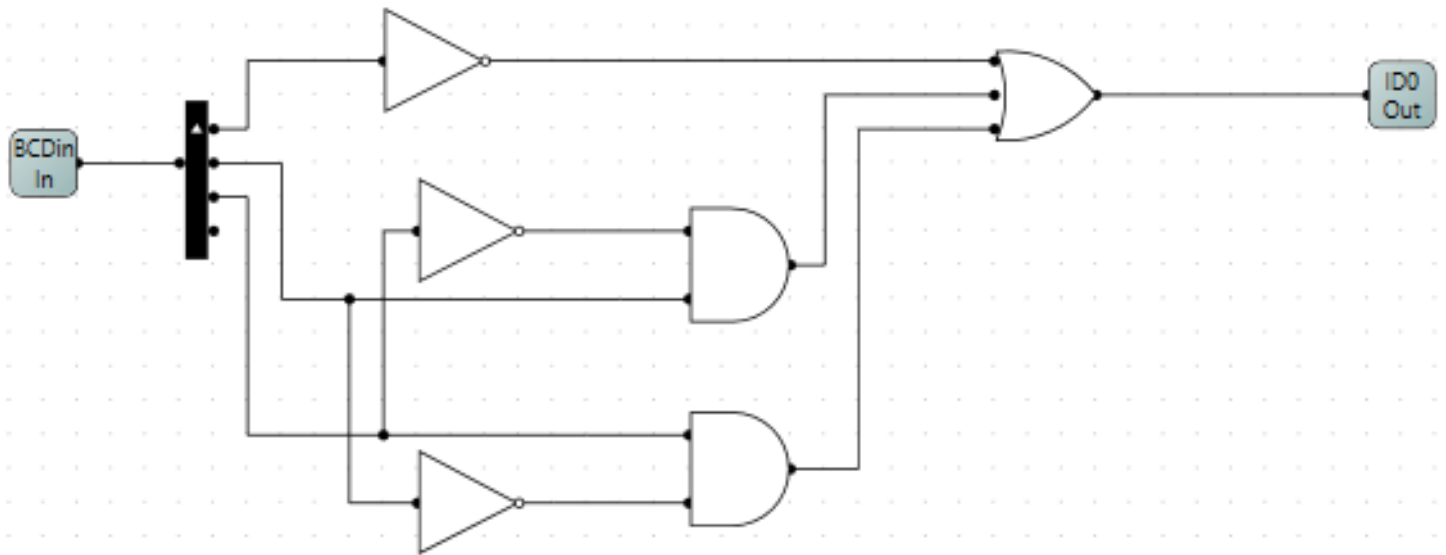
Circuit Design: $B_2 (a_0 + \bar{a}_1 \bar{a}_2 \bar{a}_3 + \bar{a}_1 a_2 a_3 + a_1 a_2 \bar{a}_3)$



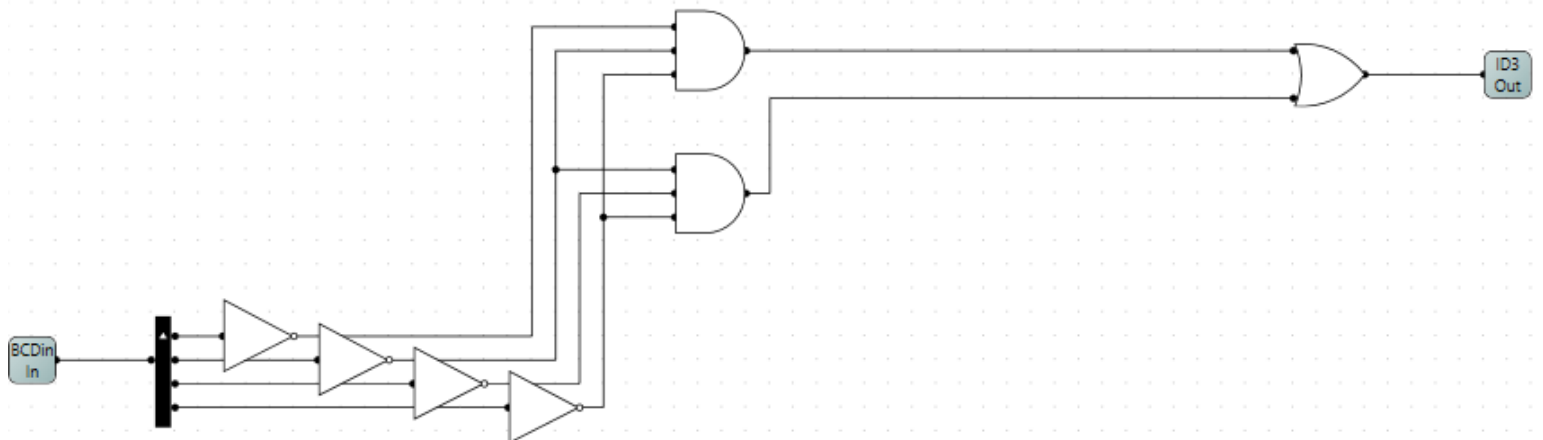
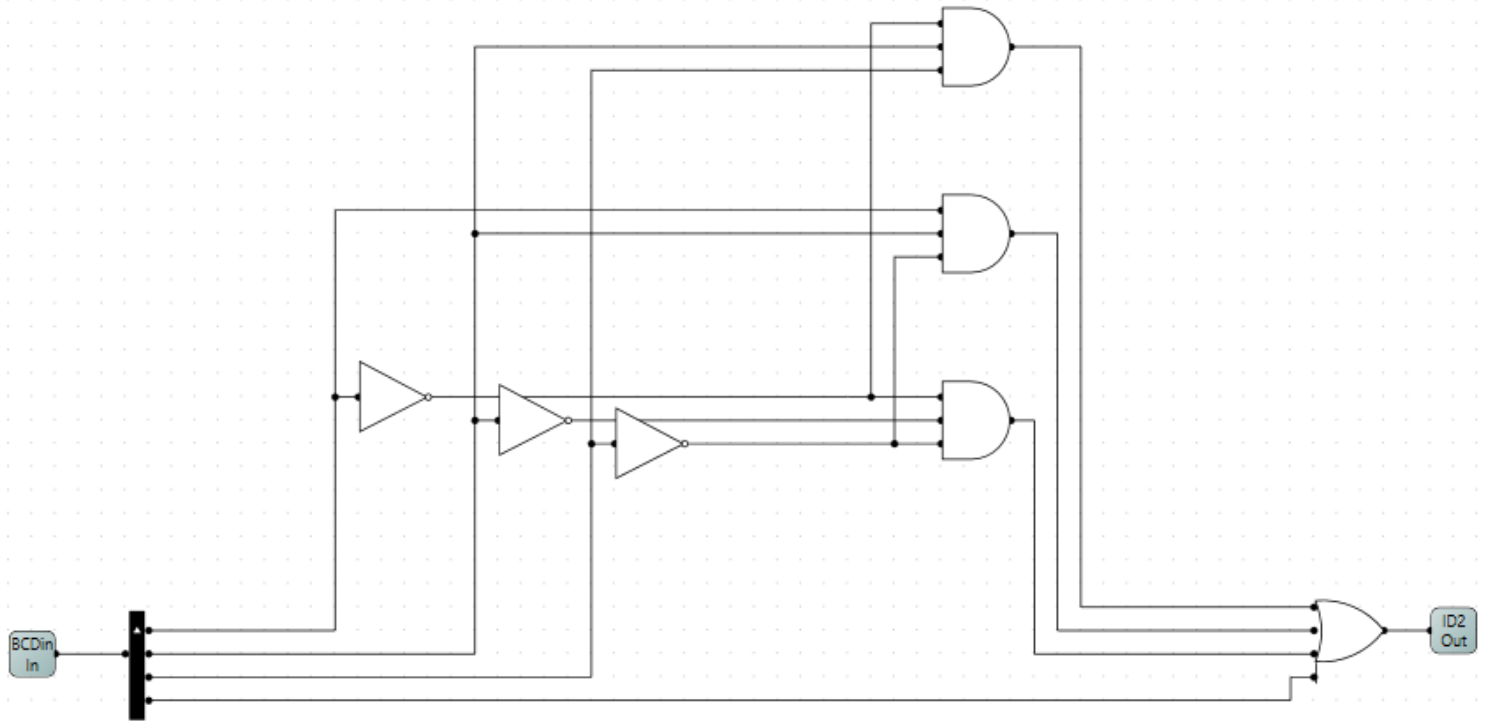
Circuit Design: $B_3 (\bar{a}_0 \bar{a}_1 \bar{a}_2 + \bar{a}_0 \bar{a}_2 \bar{a}_3)$



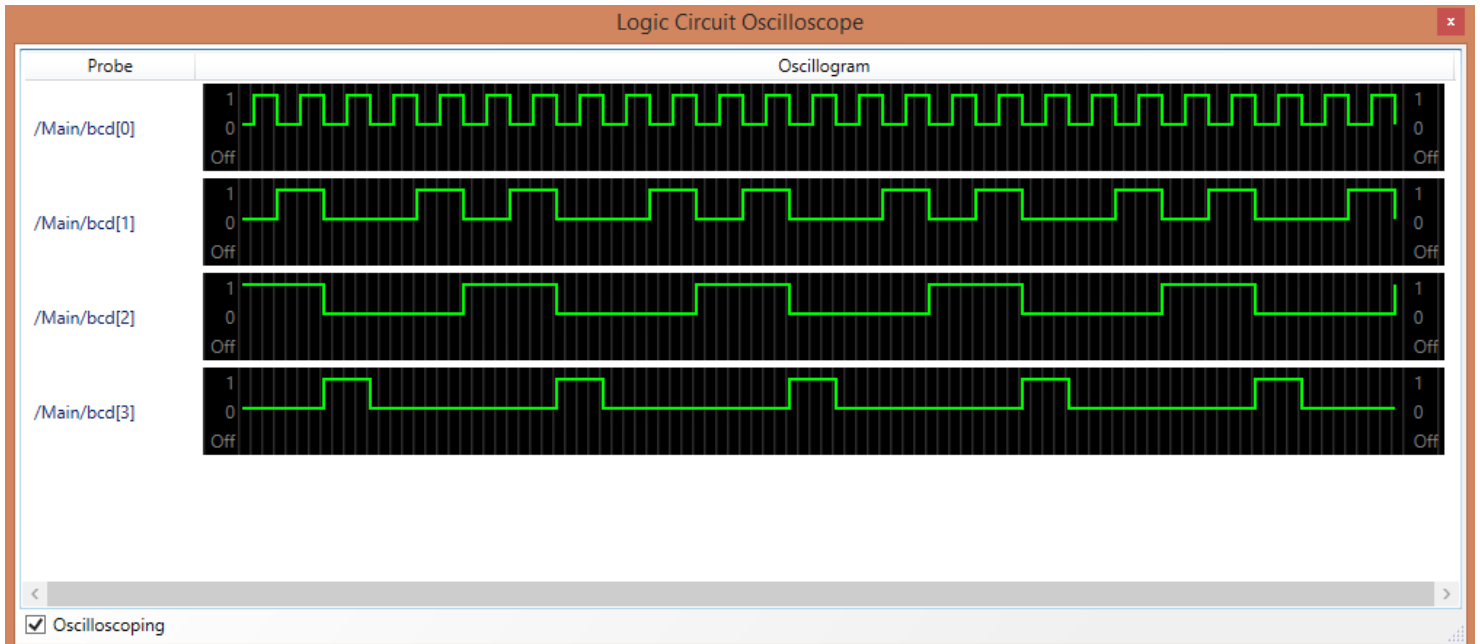
Bit 0 and Bit 1 Built Circuits:



Bit 2 and Bit 3 Built Circuits:



Oscilloscope:



Extra Credit: The extra credit required that instead of F printing, the 7-segment would blank. This was accomplished by modifying the seven segment decoder on the g-circuit logic from the left to the right:

In essence, disconnecting the and gate.

