Lab Three: BCD to Red ID Converter

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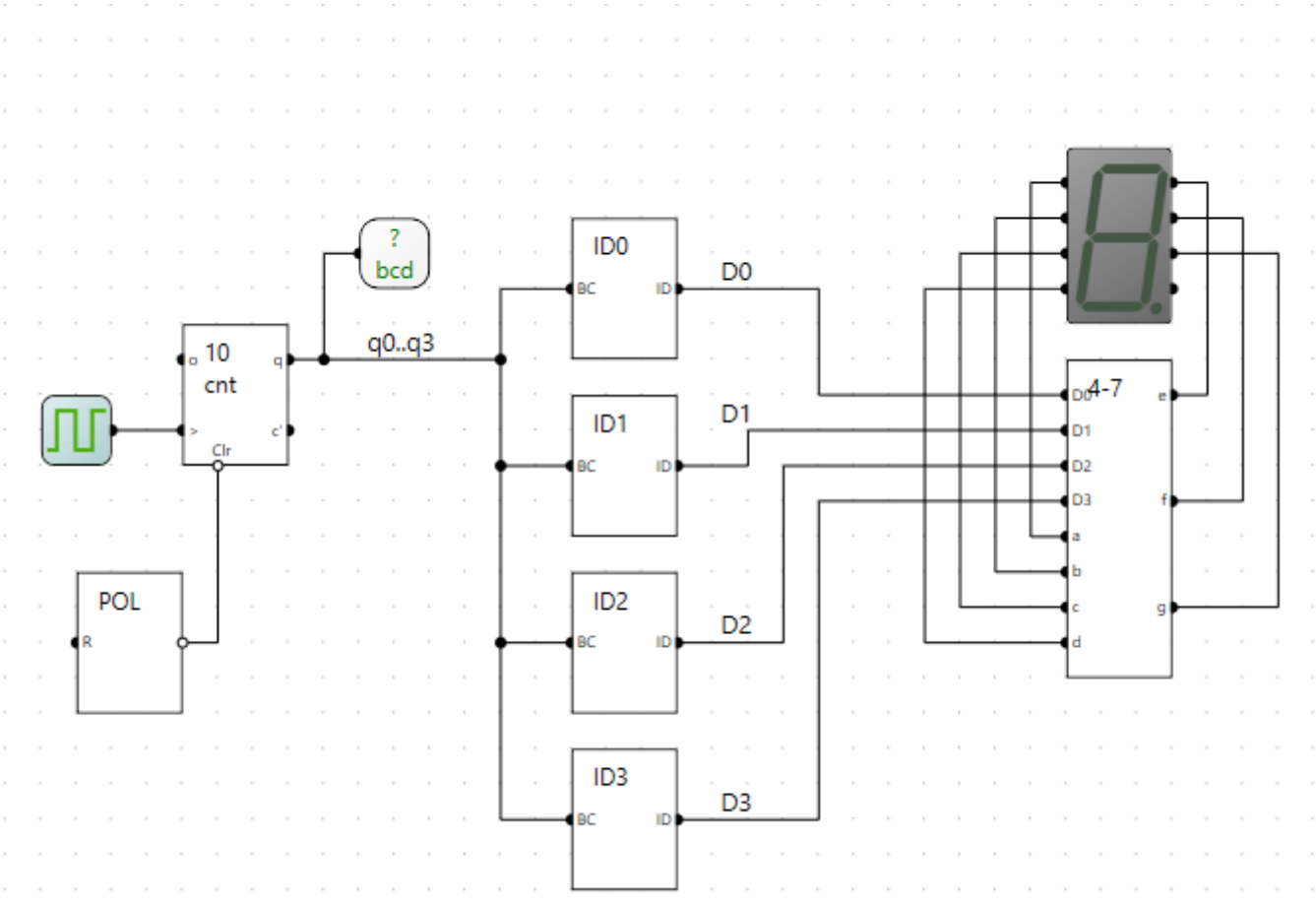
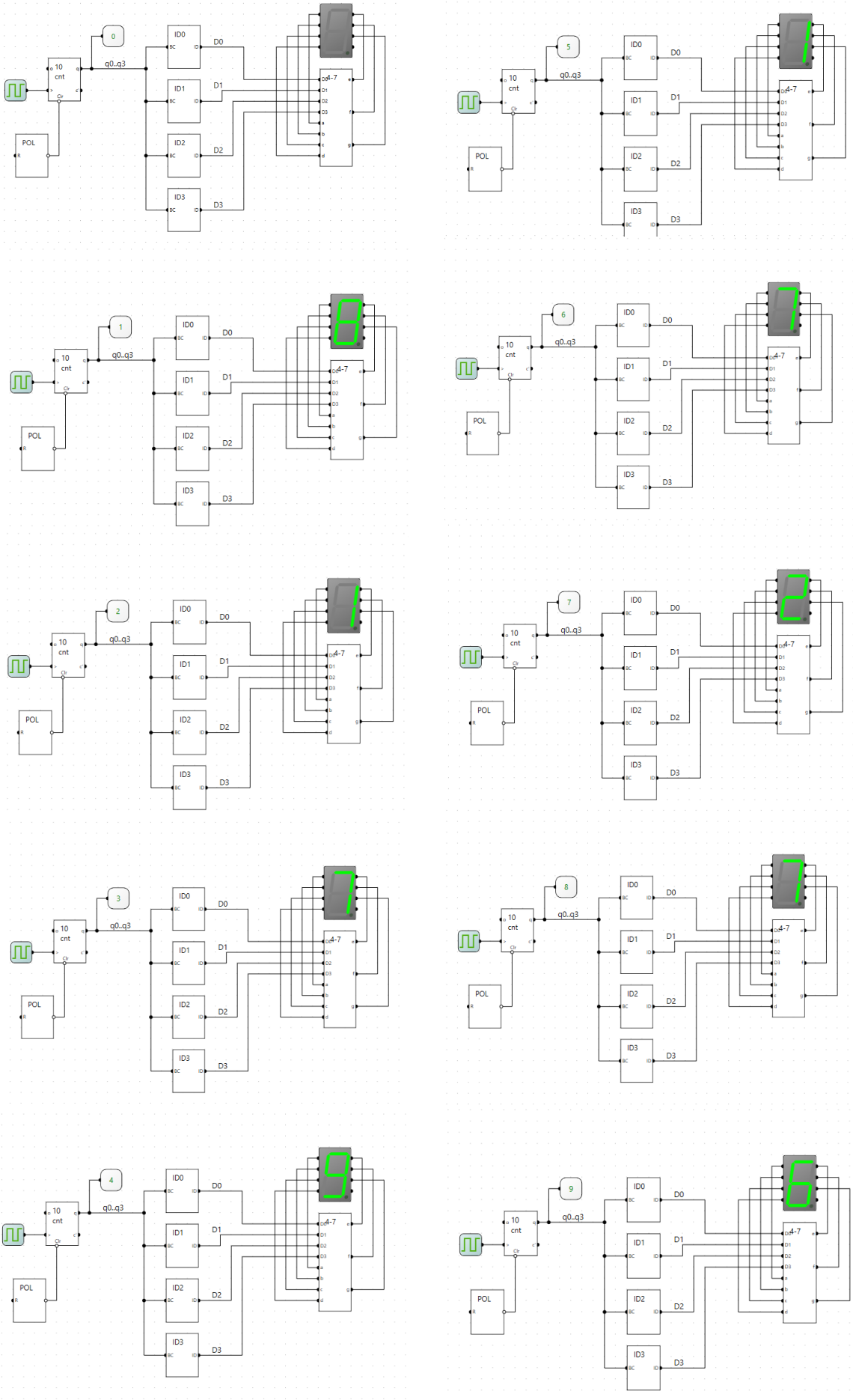
Description: This lab is supposed to print my Red ID (817917276) on a seven segment display. This is done by having a clock output into a decimal counter which counts up to 10. The decimal 10 is then converted into its binary counterpart in BCD. The BCD binary counterpart is then passed into 4 circuits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

Off Schematic



Simulation:

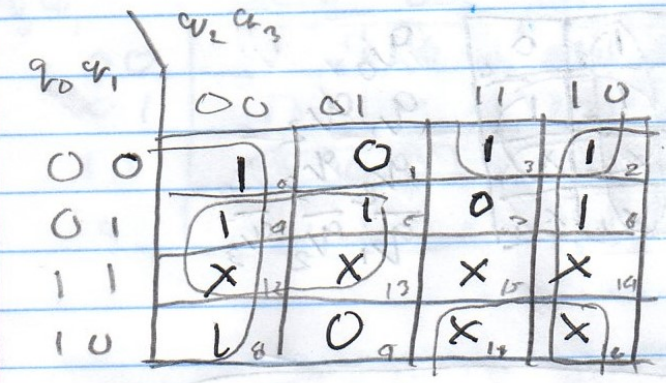


K-Map Bit 0 Worksheet:

K-Mappings Bit Ø:

Truth-Table:		(A) q_0	(B) q_1	(C) q_2	(D) q_3	b_0	term #
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 Ø:

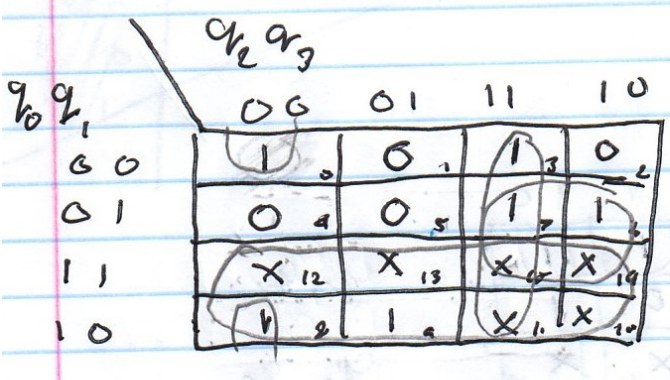


SOP: $b_0 = \bar{q}_1 q_2 + q_1 \bar{q}_2 + \bar{q}_3$

K-Map Bit 1 Worksheet:

K-Mappins Bit 1:

Truth Table:	q_0	q_1	q_2	q_3	b_1	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	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

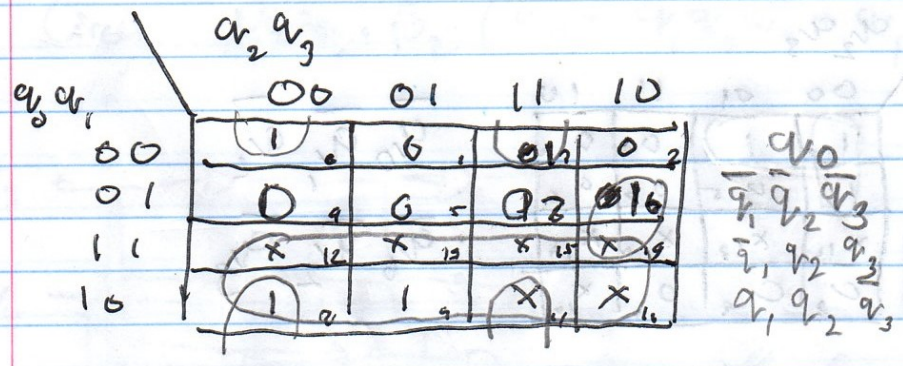


SOP: $b_1 = q_0 + q_1 q_2 + q_2 q_3 + \bar{q}_1 \bar{q}_2 \bar{q}_3$

K-Map Bit 2 Worksheet:

K-Mappins 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	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



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-Mapping 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 ———	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

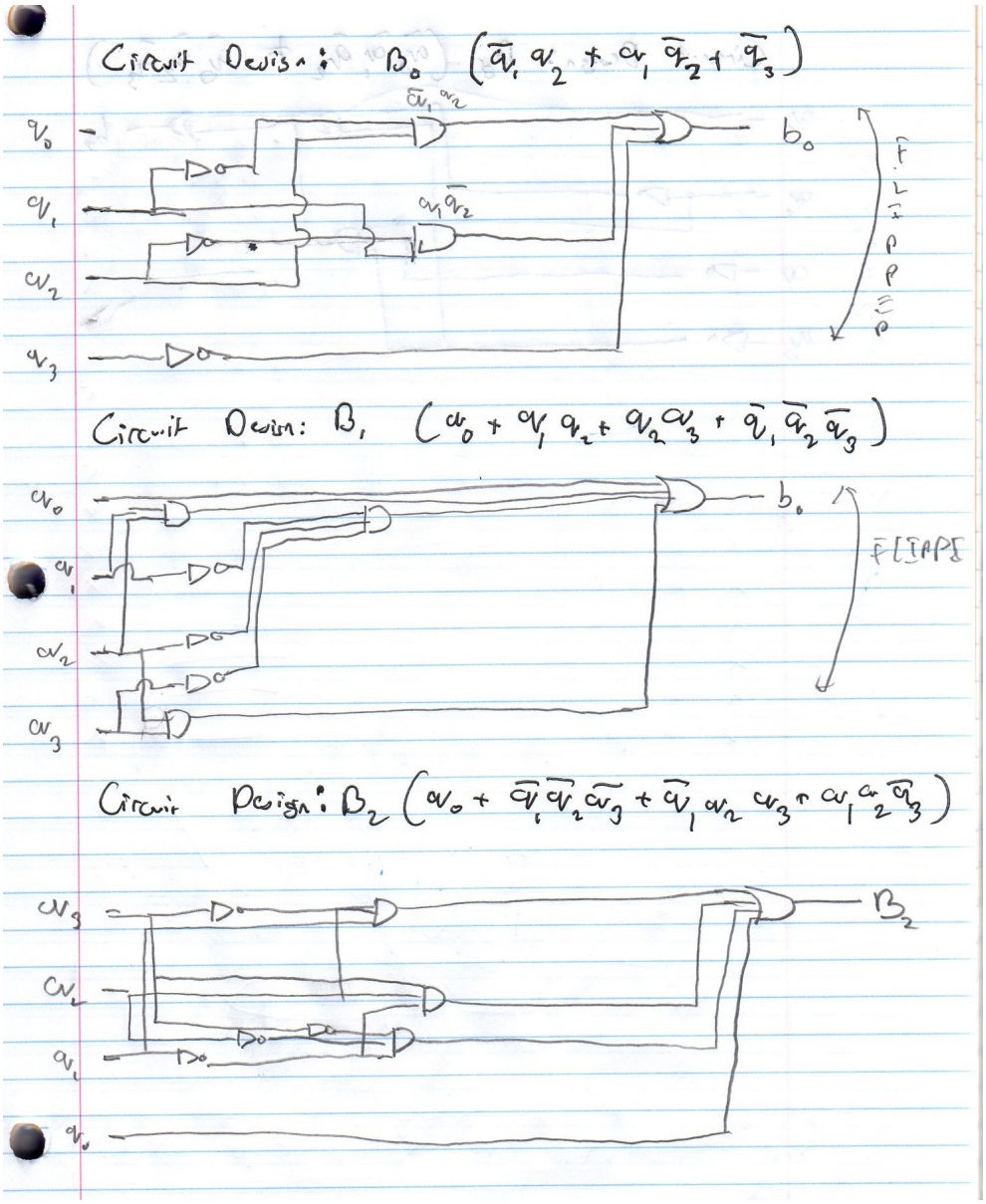
$a_0 a_1$ \ $a_2 a_3$	00	01	11	10
00	1 (0)	1 (1)	0 (3)	0 (2)
01	1 (4)	0 (5)	0 (7)	0 (6)
11	X (12)	X (13)	X (15)	X (14)
10	0 (8)	0 (9)	0 (11)	X (10)

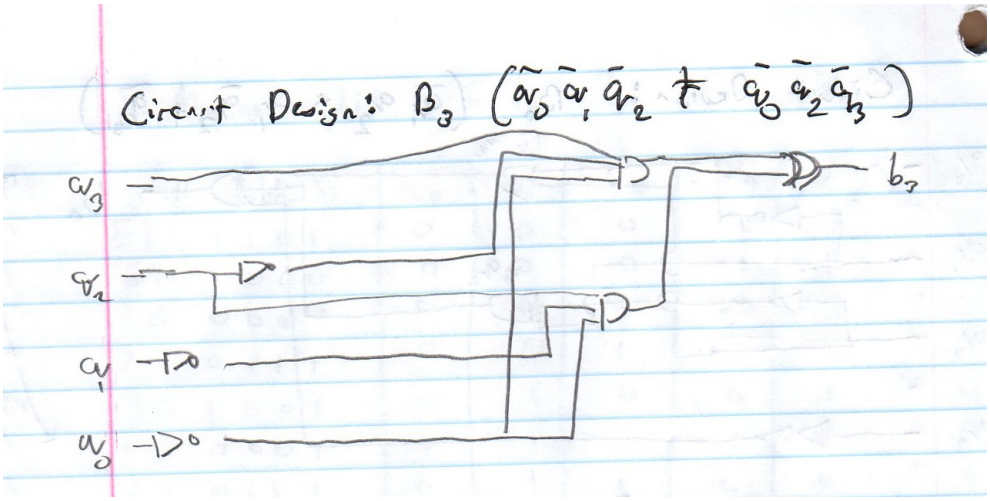
$\bar{a}_0 \bar{a}_1 \bar{a}_2$

$\bar{a}_0 \bar{a}_2 \bar{a}_3$

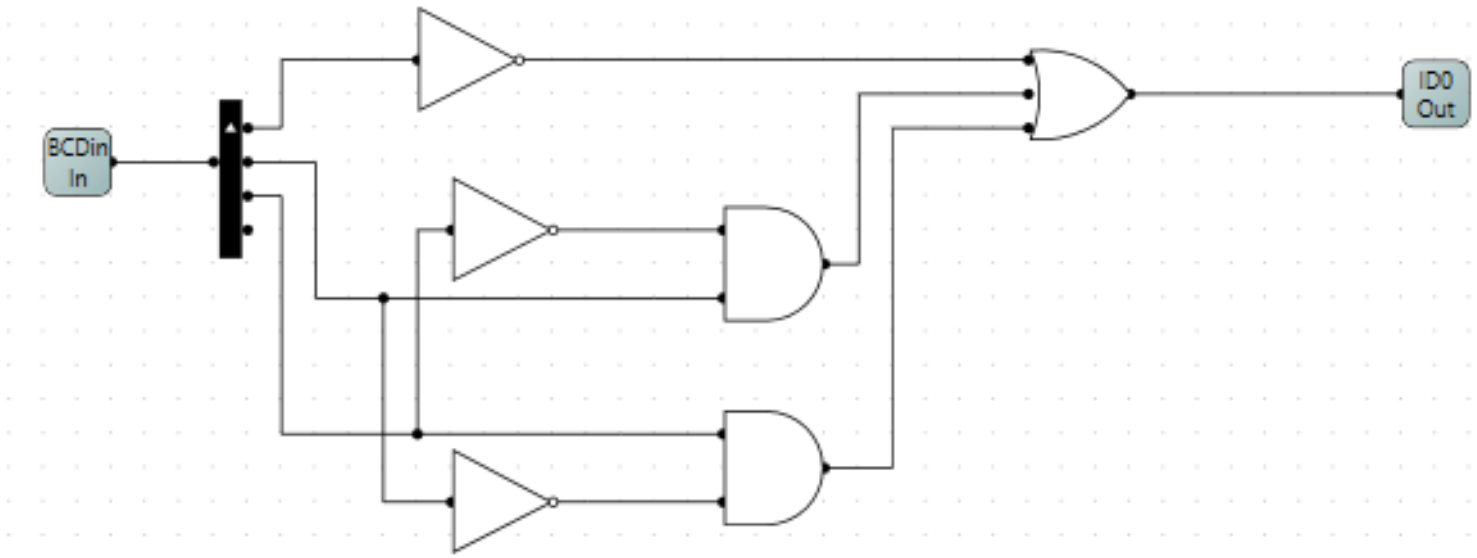
SOP: $B_3 = \bar{a}_0 \bar{a}_1 \bar{a}_2 + \bar{a}_0 \bar{a}_2 a_3$

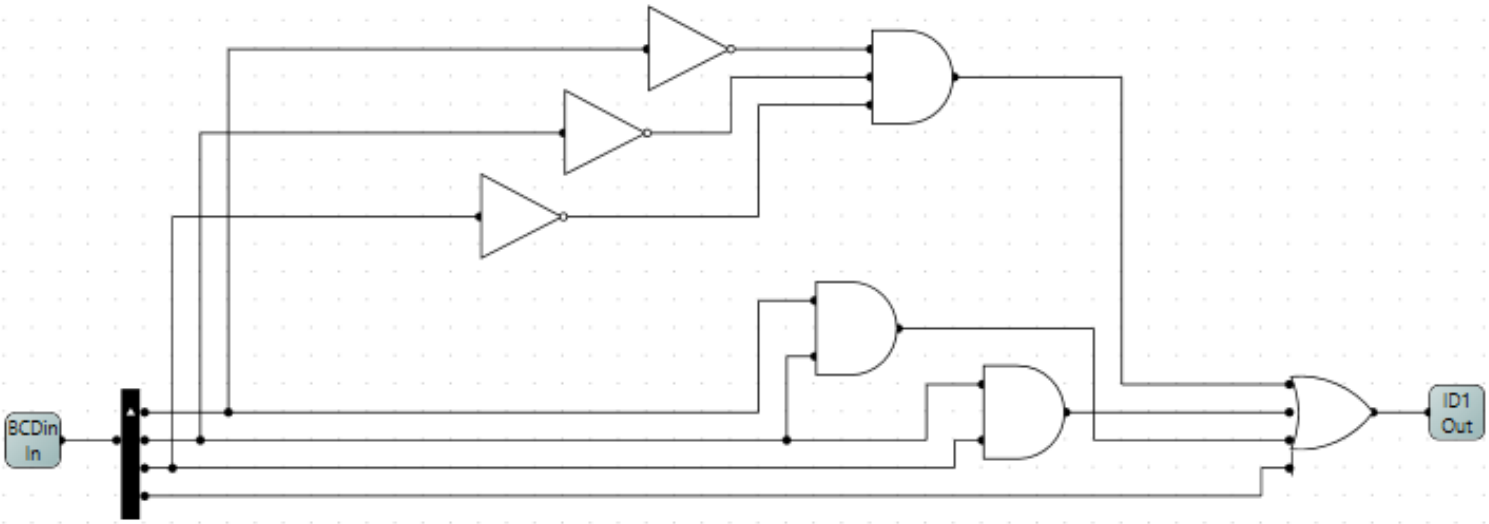
Written Circuit Designs



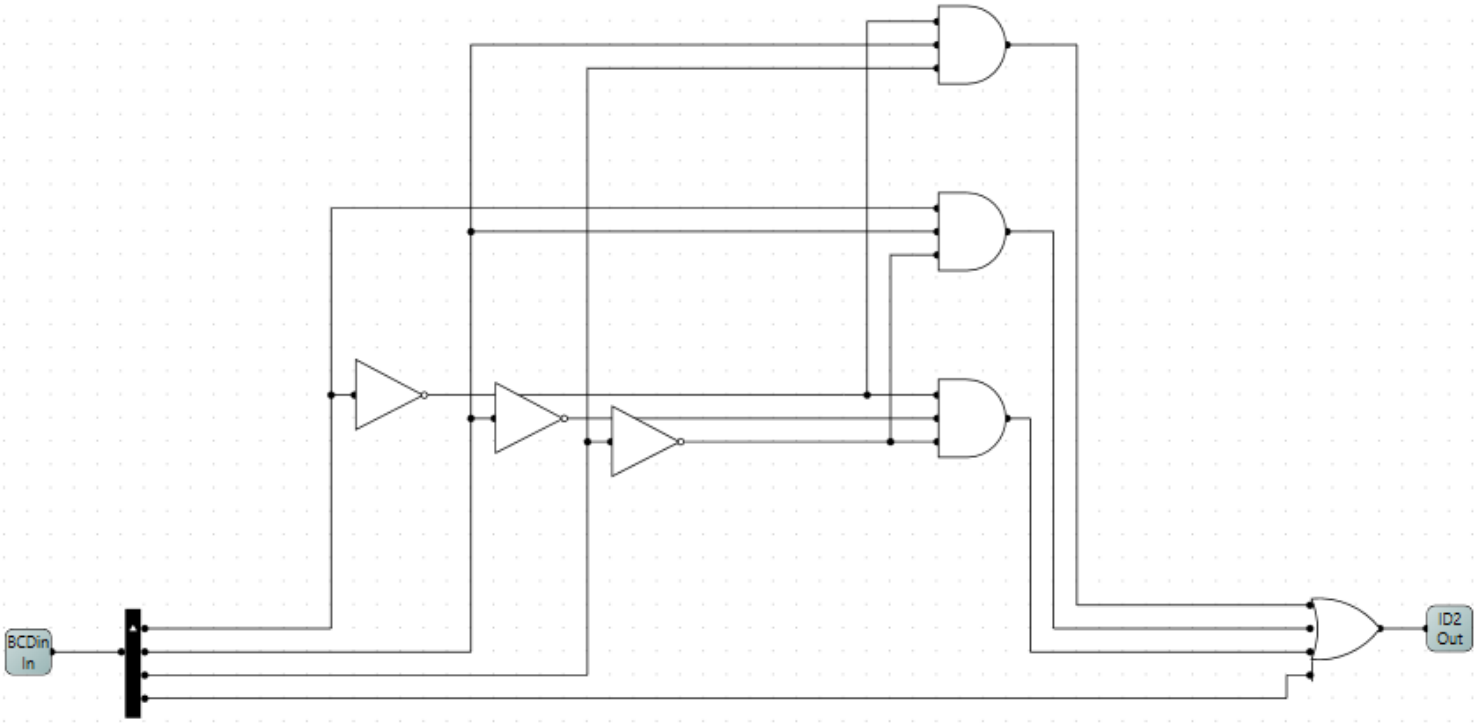


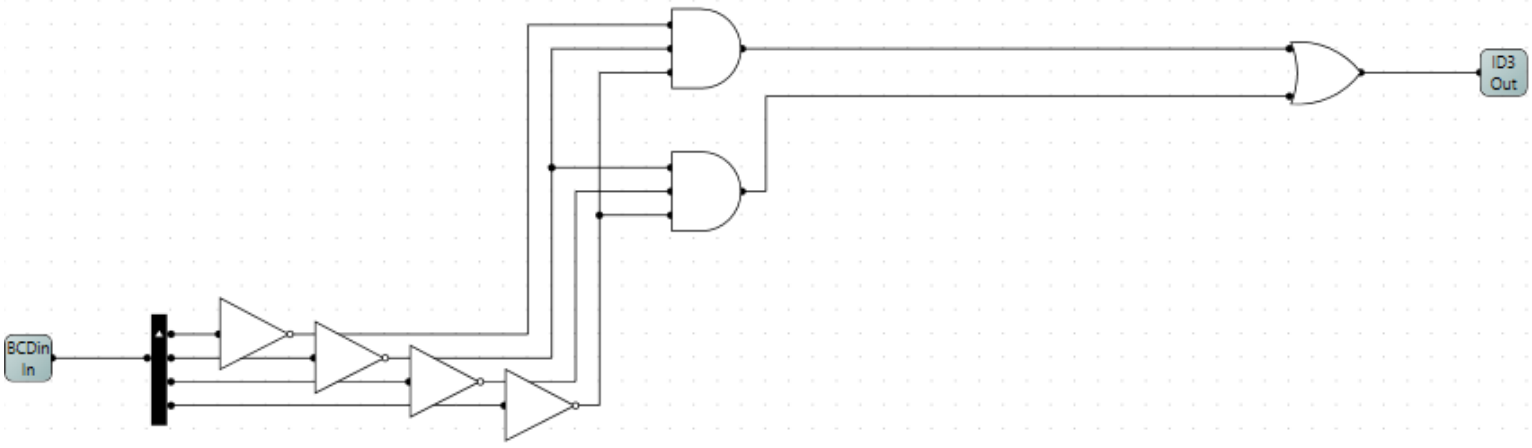
Bit 0 and Bit 1 Built Circuits:



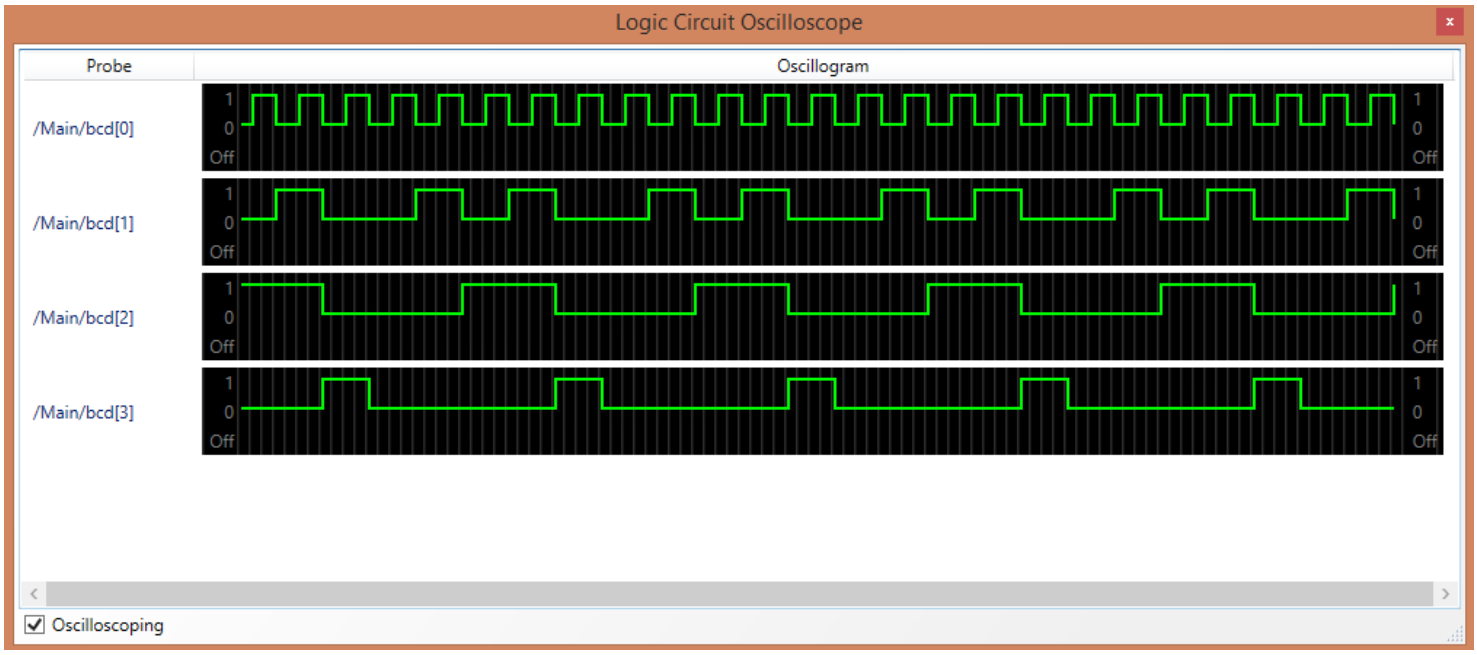


Bit 2 and Bit 3 Built Circuits:





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.