Lab 4: BCD Up/Down Counter

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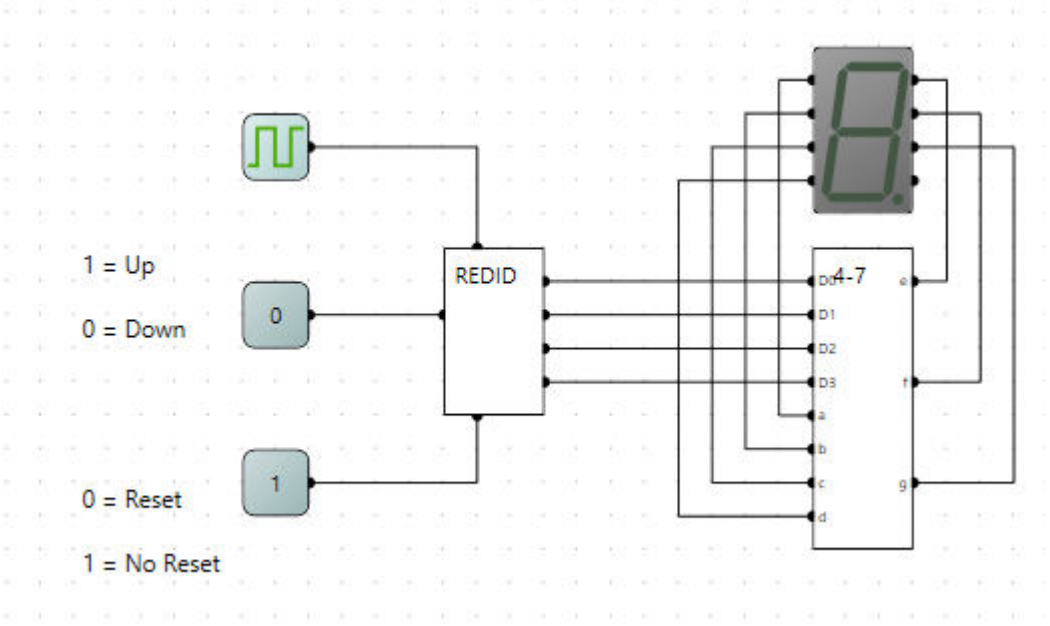
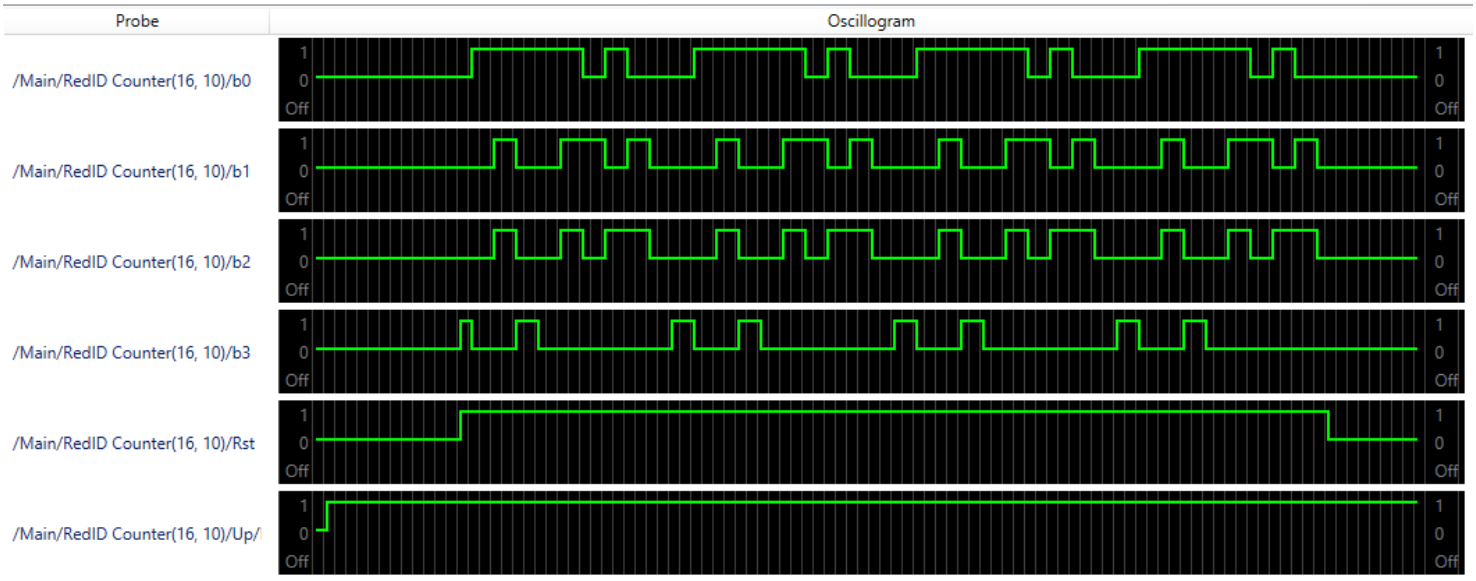
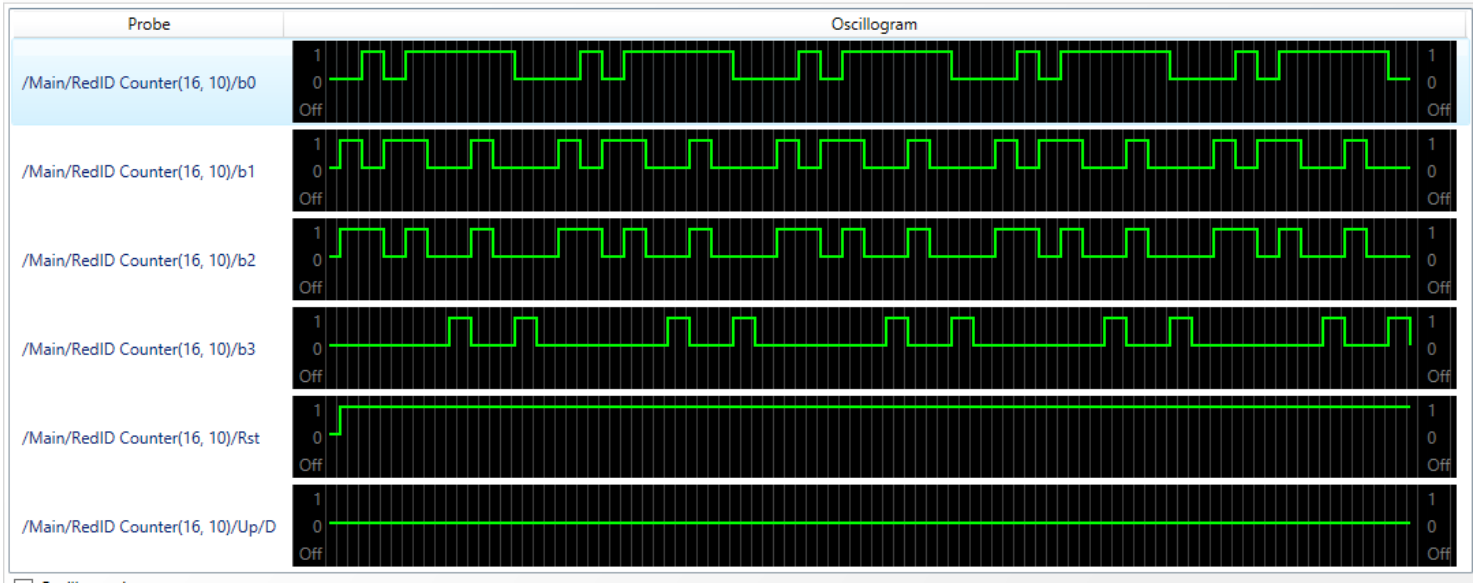
Design: This circuit was designed to print my modified RedID (817917256, replacing the 7 at the end with a 5 in order to make this project feasible) forward using finite state machines and latches. I did the extra credit, letting it count up or down.

Overall Circuit Schematic:

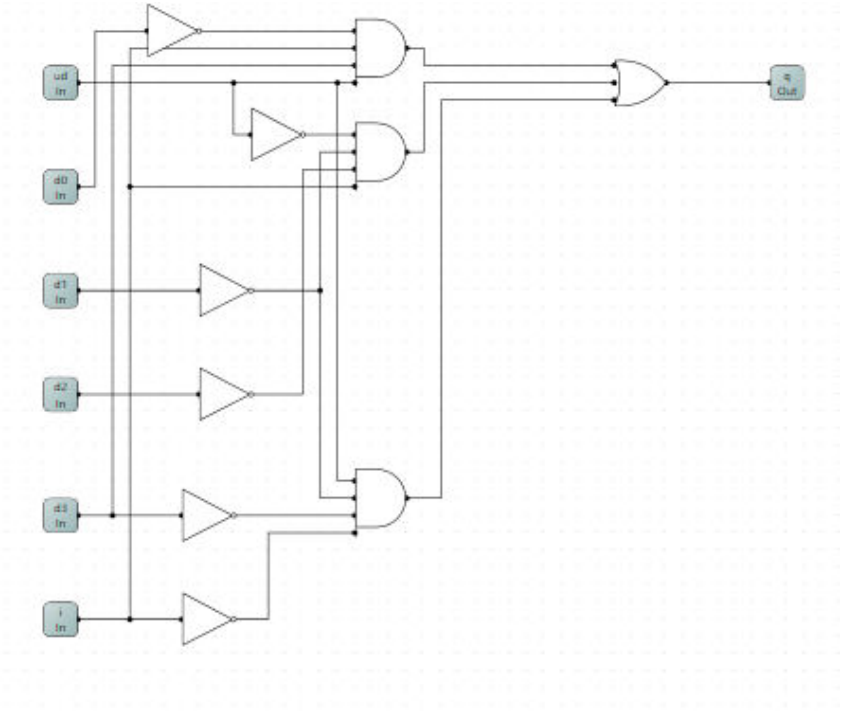


Oscilloscope for counting in BCD up and BCD down

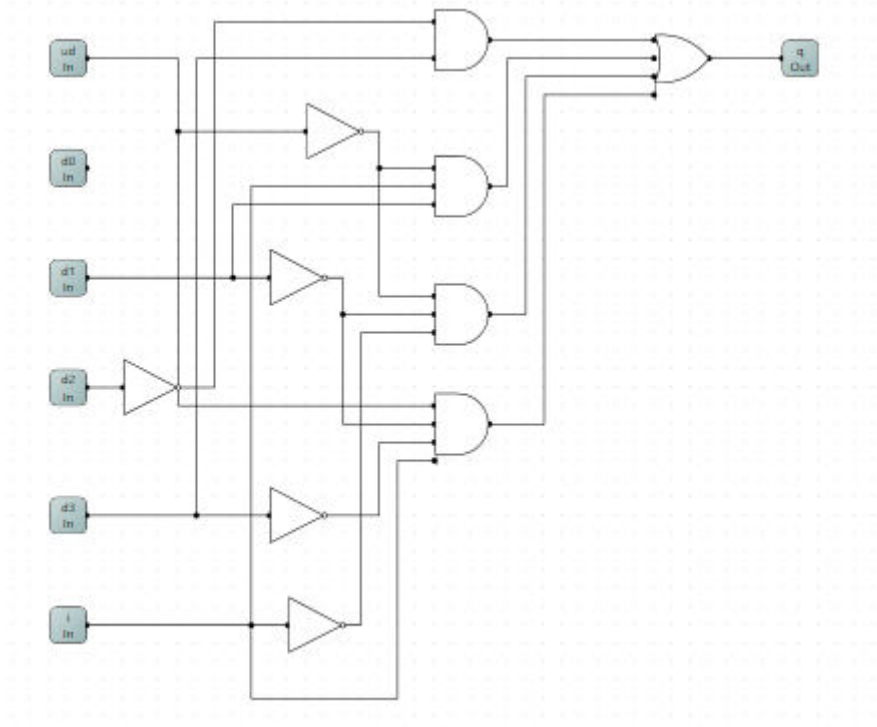




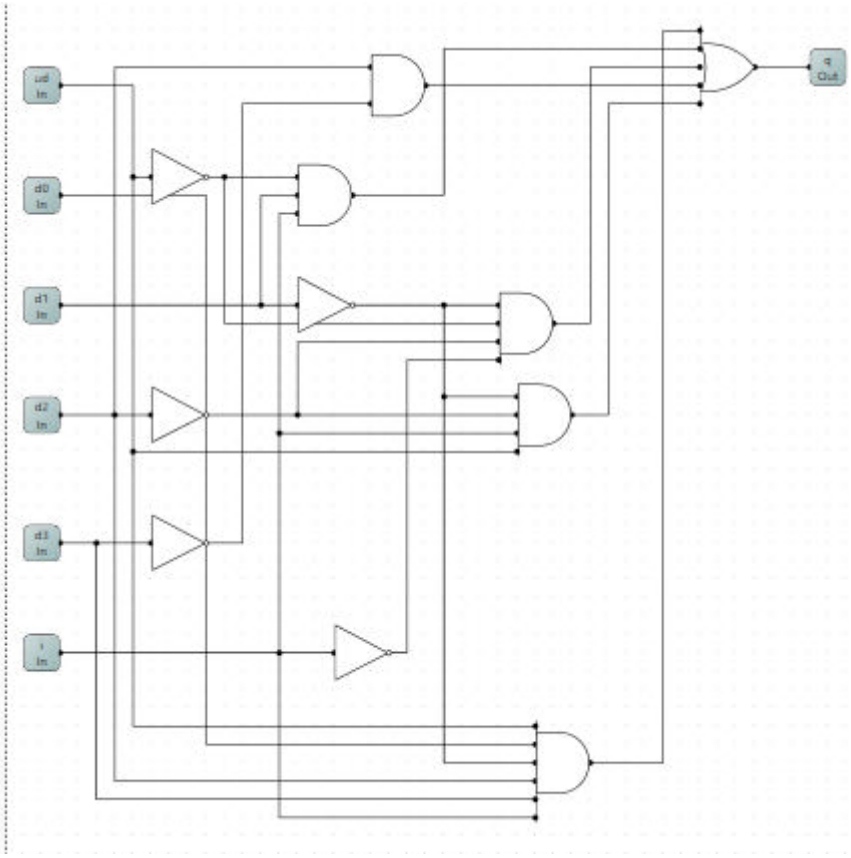
M 0, or Bit 0



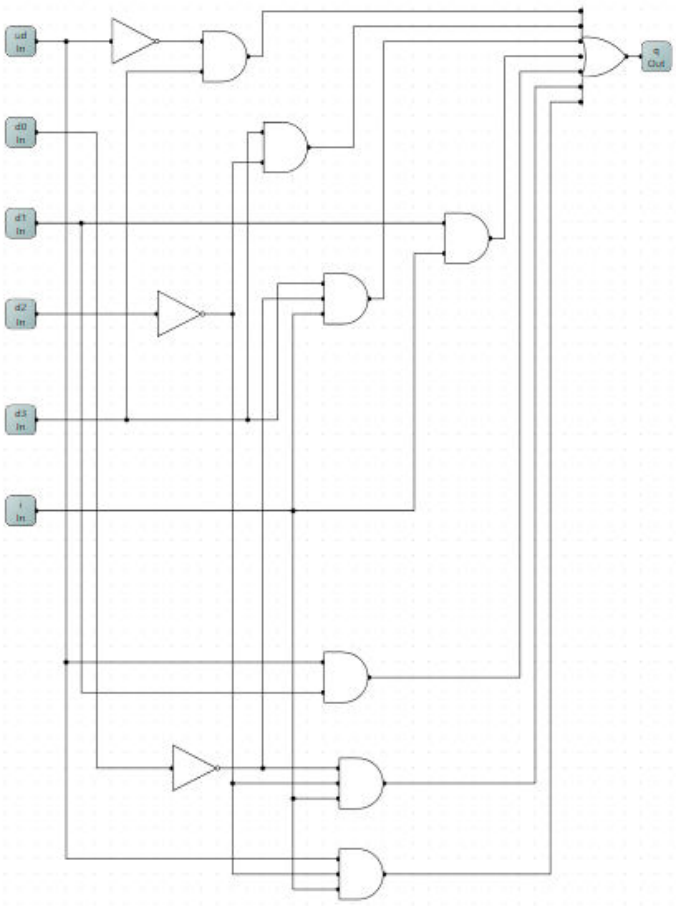
M 1, or Bit 1



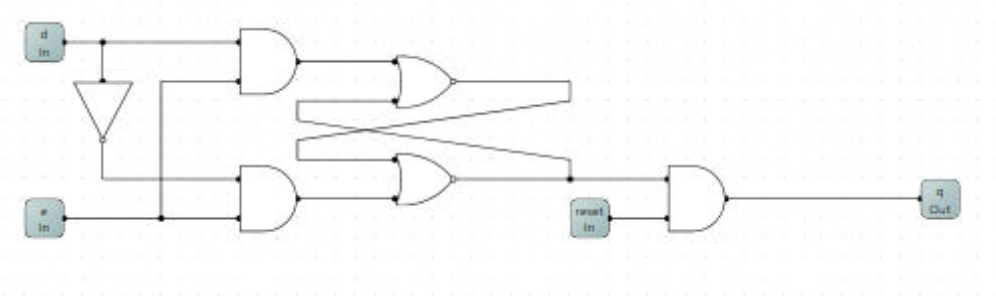
M 2, or Bit 2



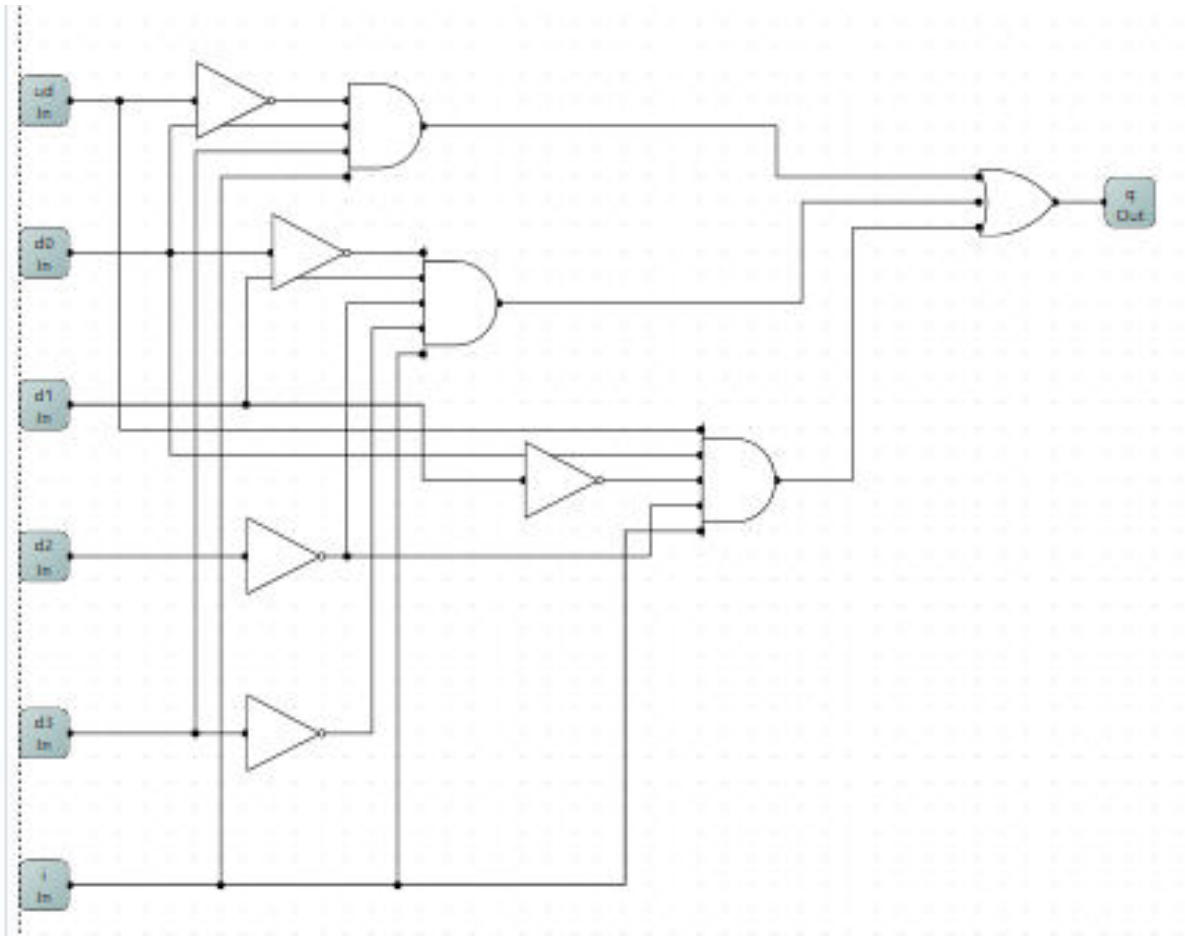
M3 or Bit 3



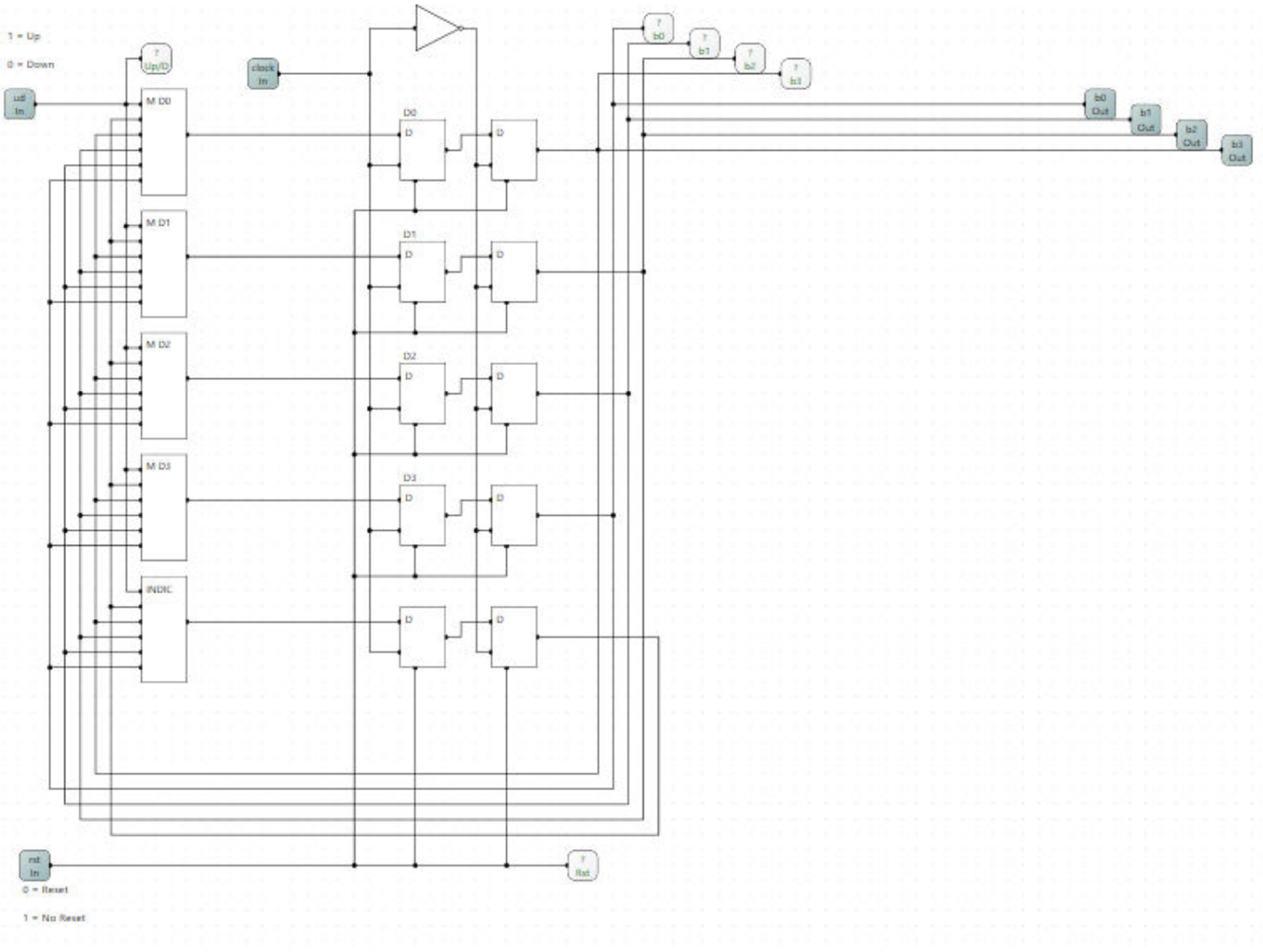
D-Latch



Indicator Logic



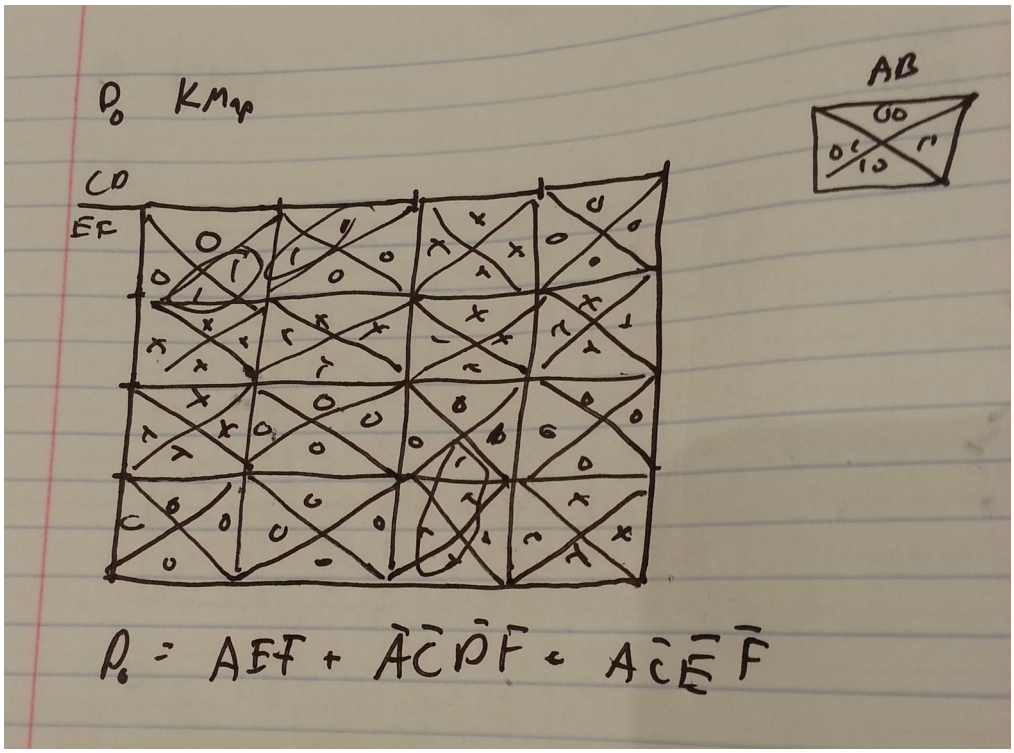
Overall Circuit Diagram



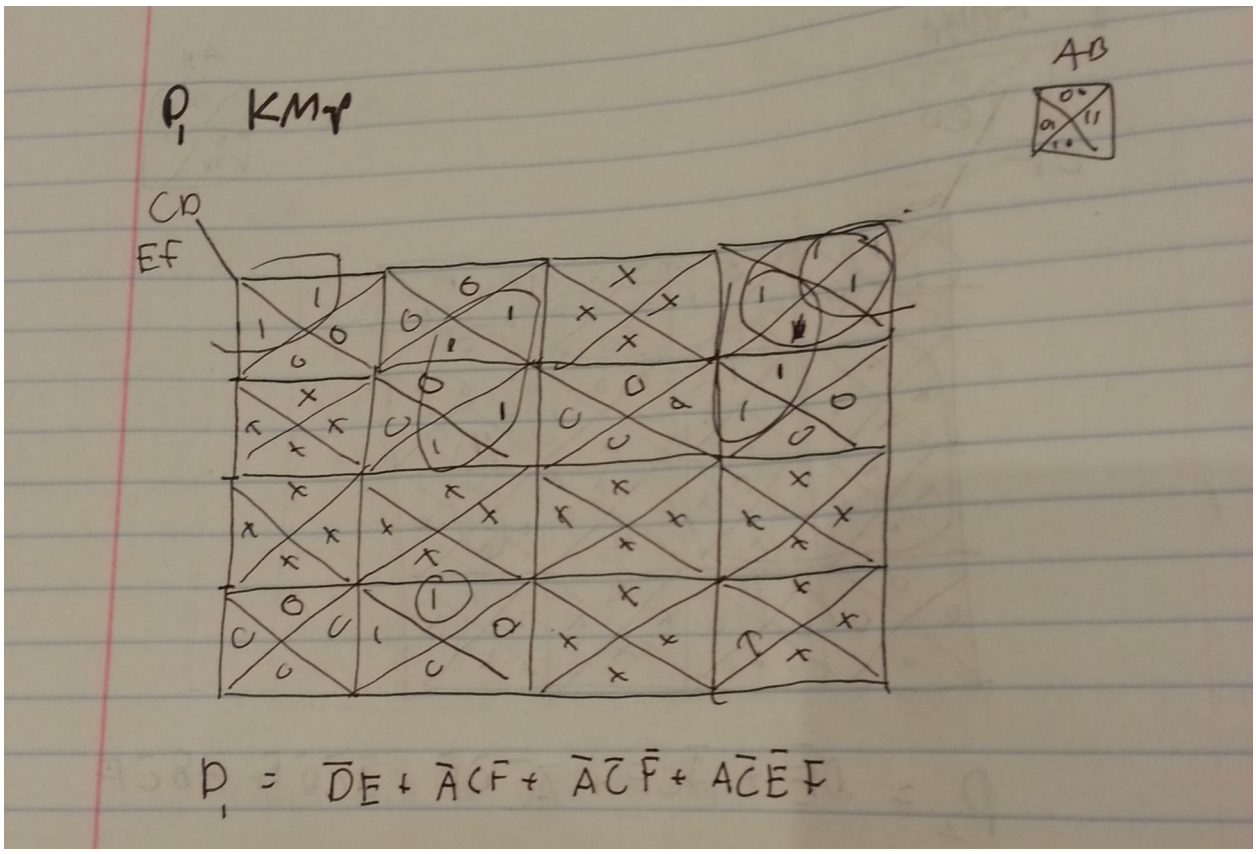
‘Master’ Truth Table

0	0	0	0	0	0	0	0	0->6	0->8	0	1	1	0	0
1	0	0	0	0	0	1	8	8->0	8->1	1	0	0	1	0
2	0	0	0	0	1	0	1	1->8	1->7	0	1	1	1	0
3	0	0	0	0	1	1	7	7->1	7->9	X	X	X	X	X
4	0	0	0	1	0	0	9	9->7	9->1	X	X	X	X	X
5	0	0	0	1	0	1	1	1->9	1->7	0	0	1	0	0
6	0	0	0	1	1	0	7	7->1	7->2	0	1	0	1	0
7	0	0	0	1	1	1	2	2->7	2->5	0	0	0	1	0
8	0	0	1	0	0	0	5	5->2	5->6	0	0	0	0	0
9	0	0	1	0	0	1	6	6->5	6->0	0	1	1	1	1
10	0	0	1	0	1	0	A	X	X	X	X	X	X	X
11	0	0	1	0	1	1	B	X	X	X	X	X	X	X
12	0	0	1	1	0	0	C	X	X	X	X	X	X	X
13	0	0	1	1	0	1	D	X	X	X	X	X	X	X
14	0	0	1	1	1	0	E	X	X	X	X	X	X	X
15	0	0	1	1	1	1	F	X	X	X	X	X	X	X
16	0	1	0	0	0	0	0			0	1	1	0	0
17	0	1	0	0	0	1	1			1	0	0	0	0
18	0	1	0	0	1	0	2			0	1	1	1	0
19	0	1	0	0	1	1	3			X	X	X	X	X
20	0	1	0	1	0	0	4			X	X	X	X	X
21	0	1	0	1	0	1	5			0	0	1	0	0
22	0	1	0	1	1	0	6			0	1	0	1	0
23	0	1	0	1	1	1	7			0	0	0	1	1
24	0	1	1	0	0	0	8			0	0	0	0	0
25	0	1	1	0	0	1	9			0	1	1	1	0
26	0	1	1	0	1	0	A	X	X	X	X	X	X	X
27	0	1	1	0	1	1	B	X	X	X	X	X	X	X
28	0	1	1	1	0	0	C	X	X	X	X	X	X	X
29	0	1	1	1	0	1	D	X	X	X	X	X	X	X
30	0	1	1	1	1	0	E	X	X	X	X	X	X	X
31	0	1	1	1	1	1	F	X	X	X	X	X	X	X
32	1	0	0	0	0	0	0		0->8	1	0	0	0	0
33	1	0	0	0	0	1	8		8->1	0	1	1	1	0
34	1	0	0	0	1	0	1		1->7	0	1	0	1	0
35	1	0	0	0	1	1	7		7->9	X	X	X	X	X
36	1	0	0	1	0	0	9		9->1	X	X	X	X	X
37	1	0	0	1	0	1	1		1->7	0	1	1	0	0
38	1	0	0	1	1	0	7		7->2	0	0	0	0	0
39	1	0	0	1	1	1	2		2->5	1	0	0	1	0
40	1	0	1	0	0	0	5		5->6	0	0	0	1	0
41	1	0	1	0	0	1	6		6->0	0	0	0	1	1
42	1	0	1	0	1	0	A	X	X	X	X	X	X	X
43	1	0	1	0	1	1	B	X	X	X	X	X	X	X
44	1	0	1	1	0	0	C	X	X	X	X	X	X	X
45	1	0	1	1	0	1	D	X	X	X	X	X	X	X
46	1	0	1	1	1	0	E	X	X	X	X	X	X	X
47	1	0	1	1	1	1	F	X	X	X	X	X	X	X
48	1	1	0	0	0	0	0			1	0	0	0	0
49	1	1	0	0	0	1	1			0	1	1	1	1
50	1	1	0	0	1	0	2			0	1	0	1	0
51	1	1	0	0	1	1	3			X	X	X	X	X
52	1	1	0	1	0	0	4			X	X	X	X	X
53	1	1	0	1	0	1	5			0	1	1	0	0
54	1	1	0	1	1	0	6			0	0	0	0	0
55	1	1	0	1	1	1	7			0	0	1	0	0
56	1	1	1	0	0	0	8			0	0	0	1	0
57	1	1	1	0	0	1	9			0	0	0	1	0
58	1	1	1	0	1	0	A	X	X	X	X	X	X	X
59	1	1	1	0	1	1	B	X	X	X	X	X	X	X
60	1	1	1	1	0	0	C	X	X	X	X	X	X	X

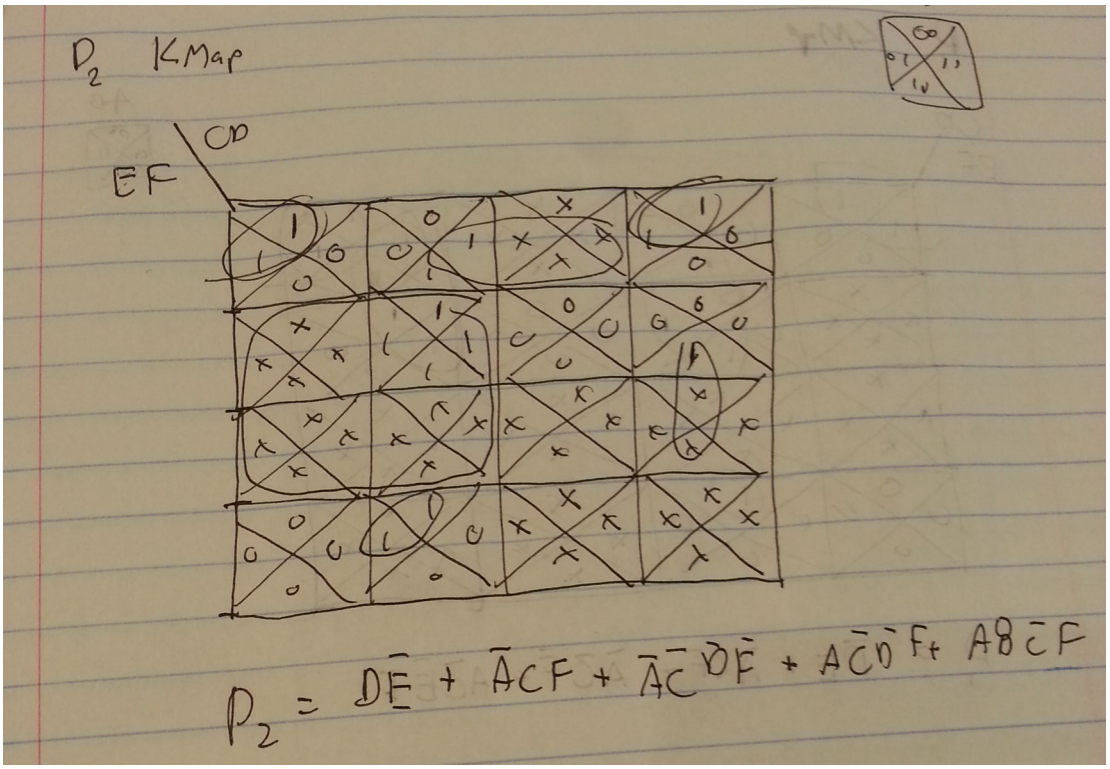
KMap D0



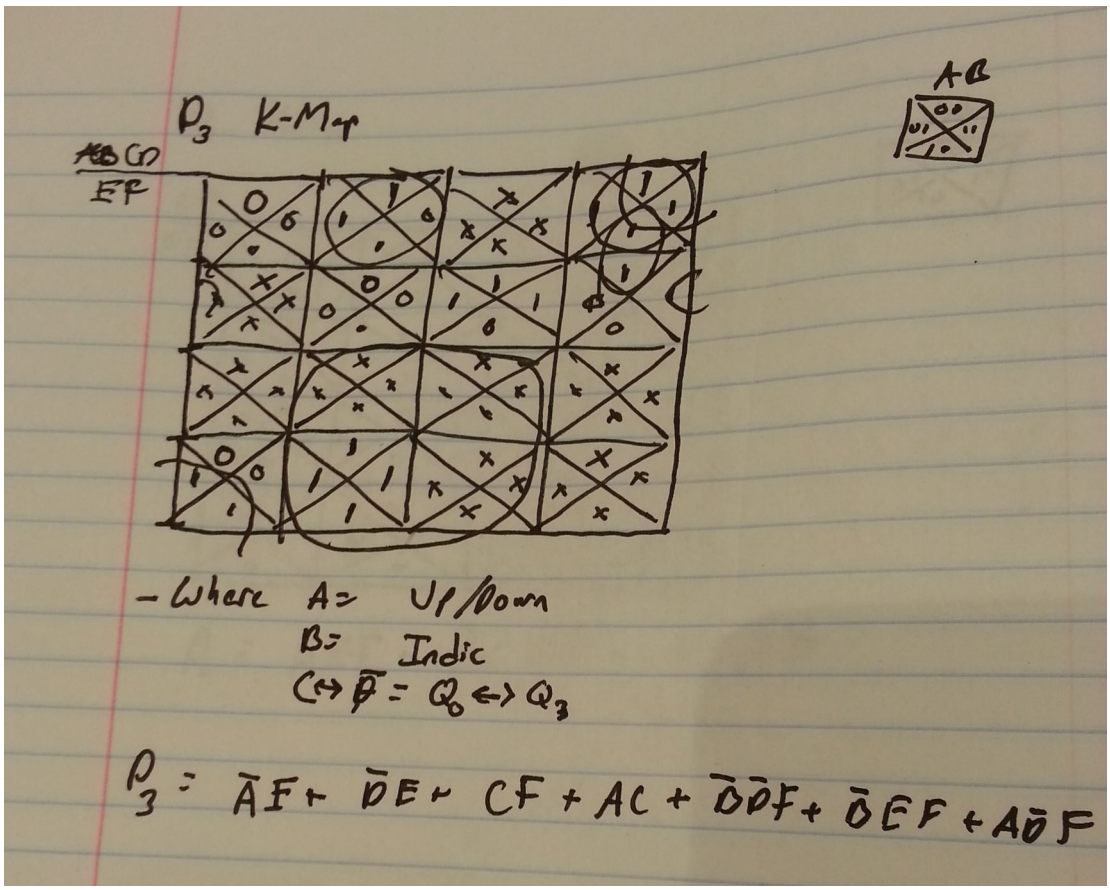
KMap D1



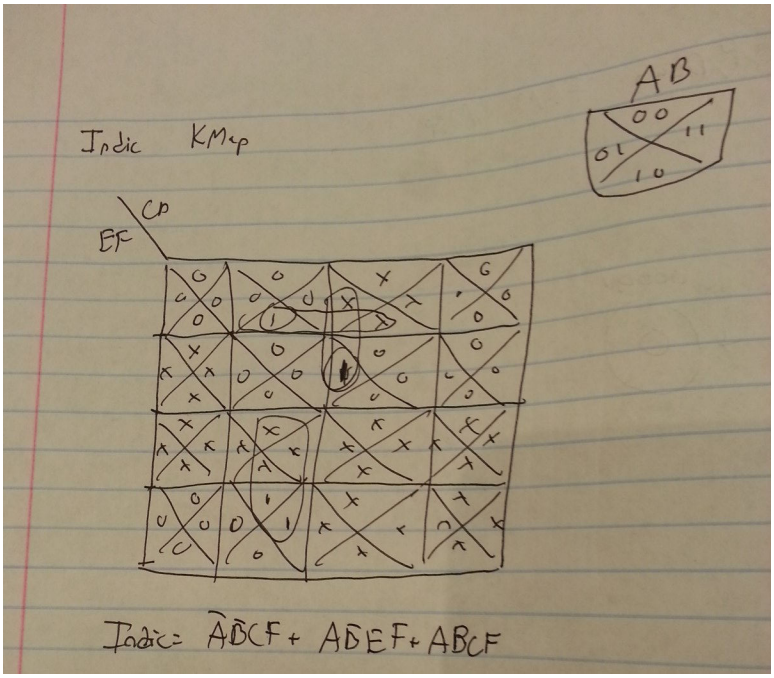
KMap D2



KMap D3



Indic KMap



FSM