

Traffic Light Controller using K-Maps, Boolean Algebra, and SimUAid

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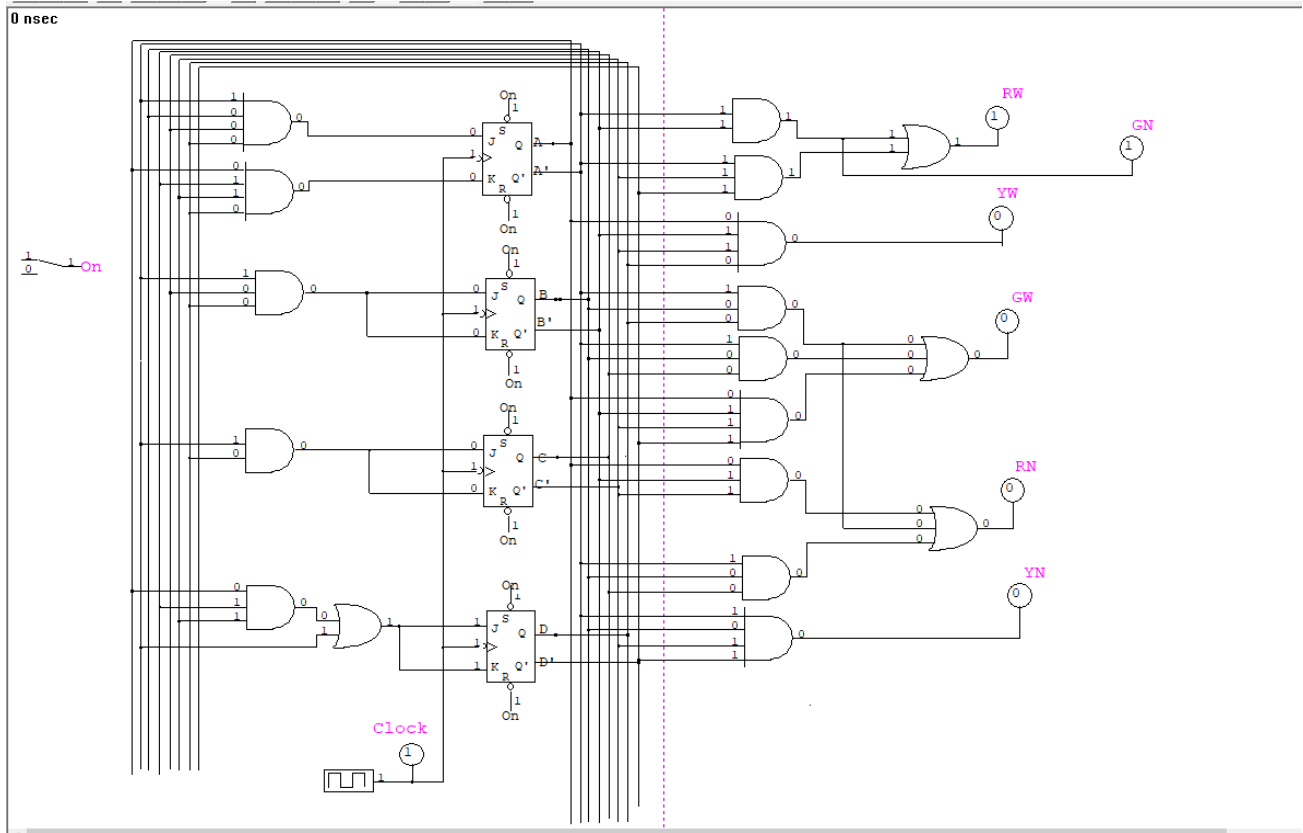


Figure 1. Schematics of the traffic controller

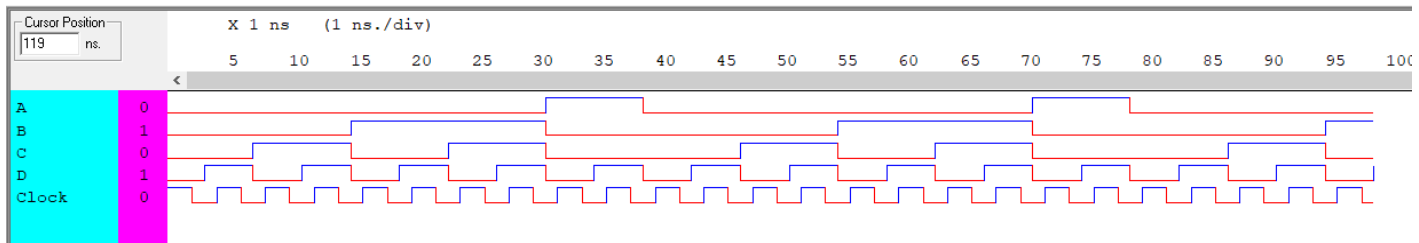


Figure 2. Time diagram of the bit counter

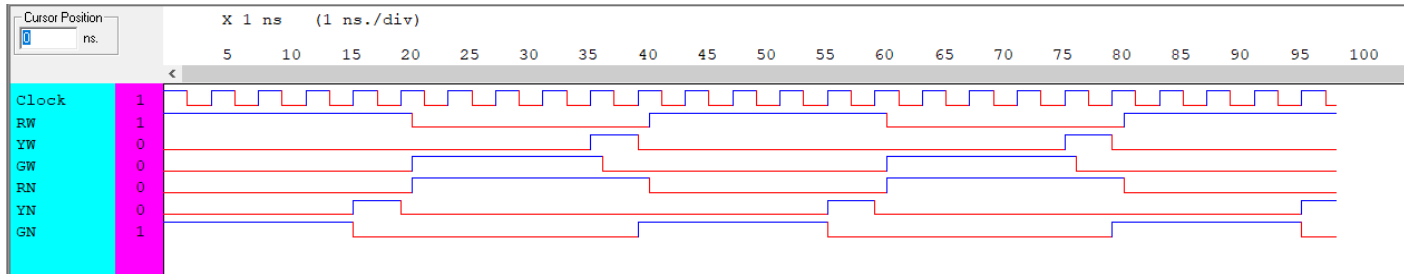


Figure 3. Time diagram for traffic lights

Table 1. Bit Counter using JK flip-flop transition table

A	B	C	D	A+	B+	C+	D+	J _A	K _A	J _B	K _B	J _C	K _C	J _D	K _D
0	0	0	0	0	0	0	1	0	x	0	x	0	x	1	x
0	0	0	1	0	0	1	0	0	x	0	x	1	x	x	1
0	0	1	0	0	0	1	1	0	x	0	x	x	0	1	x
0	0	1	1	0	1	0	0	0	x	1	x	x	1	x	1
0	1	0	0	0	1	0	1	0	x	x	0	0	x	1	x
0	1	0	1	0	1	1	0	0	x	x	0	1	x	x	1
0	1	1	0	0	1	1	1	0	x	x	0	x	0	1	x
0	1	1	1	1	0	0	0	1	x	x	1	x	1	x	1
1	0	0	0	1	0	0	1	x	0	0	x	0	x	1	x
1	0	0	1	0	0	0	0	x	1	0	x	0	x	x	1

Equations of the JK Bit counter from karnaugh map:

$$J_A = A'BCD$$

$$K_A = AB'C'D$$

$$J_B = A'CD = K_B$$

$$J_C = A'D = K_C$$

$$J_D = A' + AB'C = K_D$$

Table 2. Output

A	B	C	D	RN	YN	GN	RW	YW	GW
0	0	0	0	0	0	1	1	0	0
0	0	0	1	0	0	1	1	0	0
0	0	1	0	0	0	1	1	0	0
0	0	1	1	0	0	1	1	0	0
0	1	0	0	0	1	0	1	0	0
0	1	0	1	1	0	0	0	0	1
0	1	1	0	1	0	0	1	0	1
0	1	1	1	1	0	0	0	1	1
1	0	0	0	1	0	0	1	0	1
1	0	0	1	1	0	0	0	1	0

Equations of traffic light output after karnaugh map:

$$R_w = A'B' + A'C'D'$$

$$Y_w = AB'C'D$$

$$G_w = A'BD + A'BC + AB'C'D'$$

$$R_n = AB'C' + A'BD + A'BC$$

$$Y_n = A'BC'D'$$

$$G_n = A'B'$$

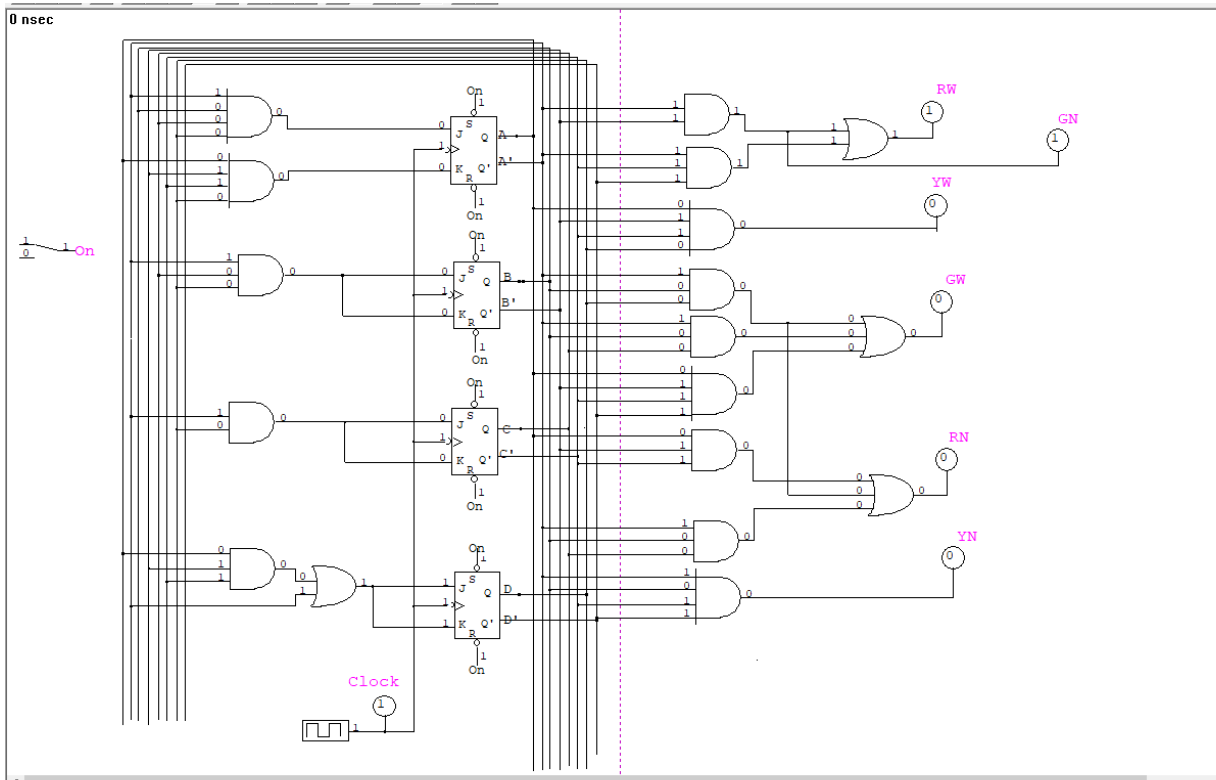


Figure 4. Schematics of the traffic controller

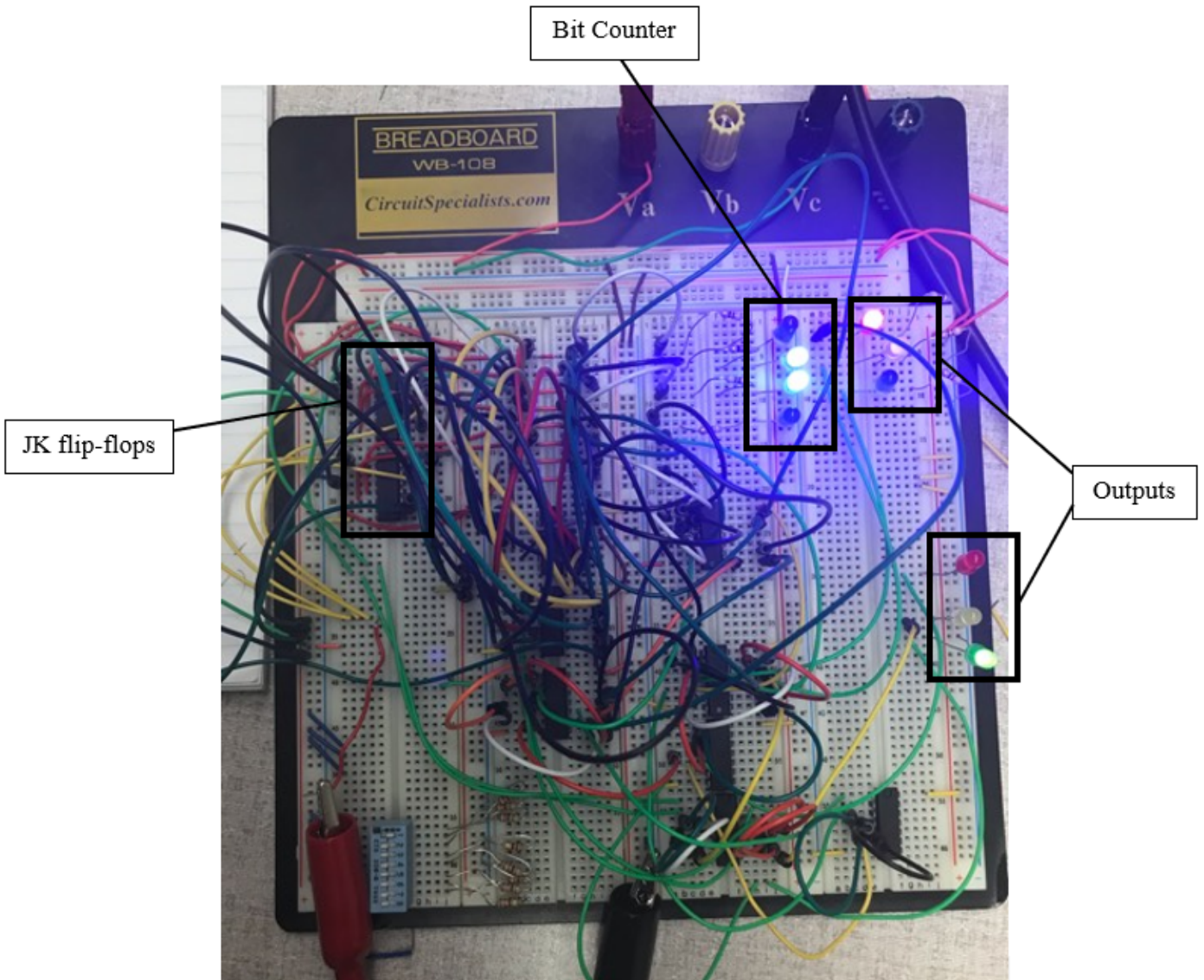


Figure 5. Traffic controller on a breadboard

Table 3. Bit Counter using JK flip-flop transition table

A	B	C	D	A+	B+	C+	D+	J _A	K _A	J _B	K _B	J _C	K _C	J _D	K _D
0	0	0	0	0	0	0	1	0	x	0	x	0	x	1	x
0	0	0	1	0	0	1	0	0	x	0	x	1	x	x	1
0	0	1	0	0	0	1	1	0	x	0	x	x	0	1	x
0	0	1	1	0	1	0	0	0	x	1	x	x	1	x	1
0	1	0	0	0	1	0	1	0	x	x	0	0	x	1	x
0	1	0	1	0	1	1	0	0	x	x	0	1	x	x	1
0	1	1	0	0	1	1	1	0	x	x	0	x	0	1	x
0	1	1	1	1	0	0	0	1	x	x	1	x	1	x	1
1	0	0	0	1	0	0	1	x	0	0	x	0	x	1	x
1	0	0	1	0	0	0	0	x	1	0	x	0	x	x	1

Equations of the JK Bit counter from karnaugh map:

$$J_A = A'BCD$$

$$K_A = AB'C'D$$

$$J_B = A'CD = K_B$$

$$J_C = A'D = K_C$$

$$J_D = A' + AB'C = K_D$$