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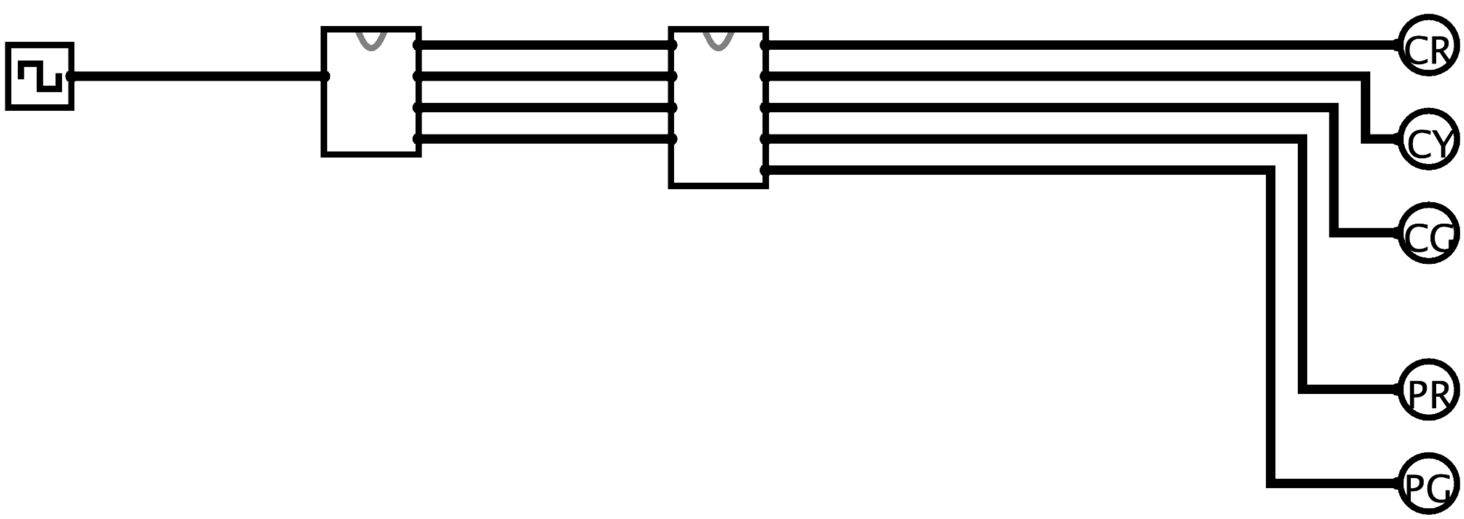
February 3, 2022

CPSC 359 Assignment 1 Report

Summary:

This sequential circuit simultaneously controls a system including a set of Red, Yellow and Green “Car lights” and a set of Red and Green “pedestrian lights” based on the ticks 0-11 of a clock. Initially, at tick 0, the state of the lights is at state “Car Green (CG)” and “Pedestrian Red (PR)”, and then moves through a series of light combinations. After tick 11, the clock and circuit reset back to the initial state - tick 0.

Final Circuit



Car Green: CG
Car Yellow: CY
Car Red: CR
Pedestrian Green: PG
Pedestrian Red: PR

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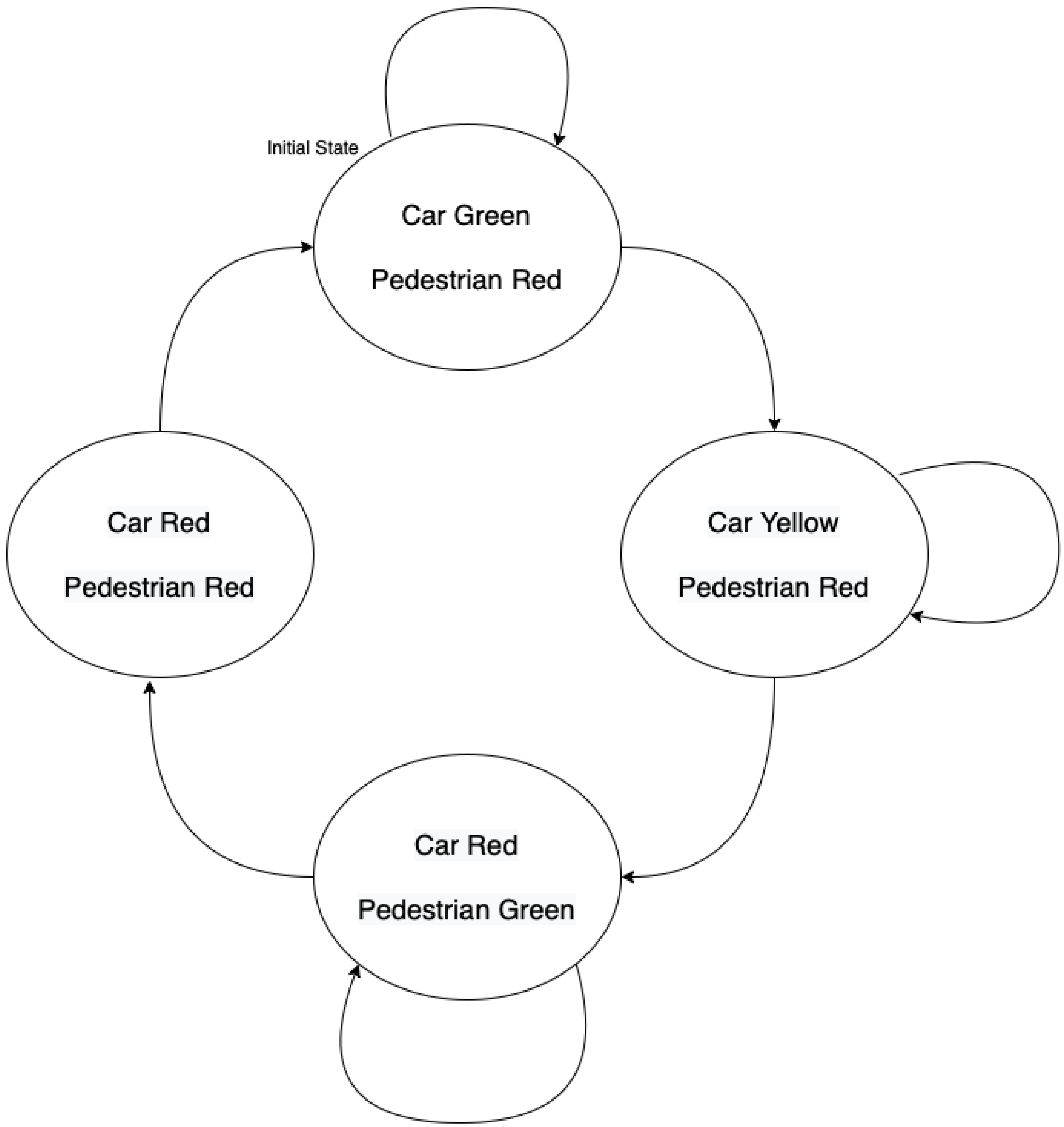
Controller

Finite State Machine:



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Controller Truth Table:

no.	x	y	z	w	**Car** CR CY CG	**Pedestrian** PG PR
0	0	0	0	0	0 0 1	0 1
1	0	0	0	1	0 0 1	0 1
2	0	0	1	0	0 0 1	0 1
3	0	0	1	1	0 0 1	0 1
4	0	1	0	0	0 0 1	0 1
5	0	1	0	1	0 0 1	0 1
6	0	1	1	0	0 1 0	0 1
7	0	1	1	1	0 1 0	0 1
8	1	0	0	0	1 0 0	1 0
9	1	0	0	1	1 0 0	1 0
10	1	0	1	0	1 0 0	1 0
11	1	0	1	1	1 0 0	0 1

Car Green: 001
Car Yellow: 010
Car Red: 100
Pedestrian Green: 10
Pedestrian Red: 01

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Controller Boolean Sum of Products & Simplification

Car:

For Car Red (CR):

CR is positive at ticks 8, 9, 10 and 11 therefore the Boolean Sum of Products is:

= xy'z'w' + xy'z'w + xy'zw' + xy'zw

Simplification with K-Map

m0	m1	m3	m2
m4	m5	m7	m6
m12	m13	m15	m14
m8	m9	m11	m10

Using adjacency of m8,m9,m11,m10:

= xy'z'(w'+w) + xy'z(w'+w)

= xy'z' + xy'z

= xy'(z'+z)

CR = xy'

For Car Yellow (CY):

CY is positive at ticks 6 and 7. Therefore the Boolean Sum of Products is:

= x'yzw' + x'yzw

Simplification with K-Map

m0	m1	m3	m2
m4	m5	m7	m6
m12	m13	m15	m14
m8	m9	m11	m10

Using adjacency of m7,m6:

= x'yz(w'+w)

CY = x'yz

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<u>For Car Green (CG):</u>

CG is positive at ticks 0, 1, 2, 3, 4, 5. Therefore the Boolean Sum of Products is:

= x’y’z’w’ + x’y’z’w+ x’y’zw’ + x’y’zw + x’yz’w’ + x’yz’w

Simplification with K-Map

m0	m1	m3	m2
m4	m5	m7	m6
m12	m13	m15	m14
m8	m9	m11	m10

Using adjacency of m0,m1,m3,m2 and m4,m5, m0, m1:

= x’y’(z’w’ + z’w + zw’ + zw) + x’z’(yw’+yw+y’w’+y’w)

CG = x’y’ + x’z’

Pedestrian:

<u>For Pedestrian Green (PG):</u>

PG is positive at ticks 8, 9, and 10. Therefore the Boolean Sum of Products is:

= xy’z’w’ + xy’z’w + xy’zw’

Simplification with K-Map

m0	m1	m3	m2
m4	m5	m7	m6
m12	m13	m15	m14
m8	m9	m11	m10

Using adjacency of m8,m9 and m8, m10:

= xy’z’w’ + xy’z’w + xy’zw’ + xy’z’w’

= xy’z’(w’+w) + xy’w’(z’+z)

PG = xy’z’+xy’w’

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For Pedestrian Red (PR):

PR is positive at ticks 0, 1, 2, 3, 4, 5, 6, 7, 11. Therefore the Boolean Sum of Products is:

= x’y’z’w’ + x’y’z’w+ x’y’zw’ + x’y’zw + x’yz’w’ + x’yz’w + x’yzw’+ x’yzw+ xy’zw

Simplification with K-Map

m0	m1	m3	m2
m4	m5	m7	m6
m12	m13	m15	m14
m8	m9	m11	m10

Using adjacency of m0,m1,m3,m2 and m4,m5, m7, m6 and m3, m11:

= x’y’(z’w’ + z’w + zw’ + zw) + x’y(z’w’ + z’w + zw’+ zw) + xy’zw + x’y’zw

= x’y’ + x’y + y’zw

PR = x’ + y’zw

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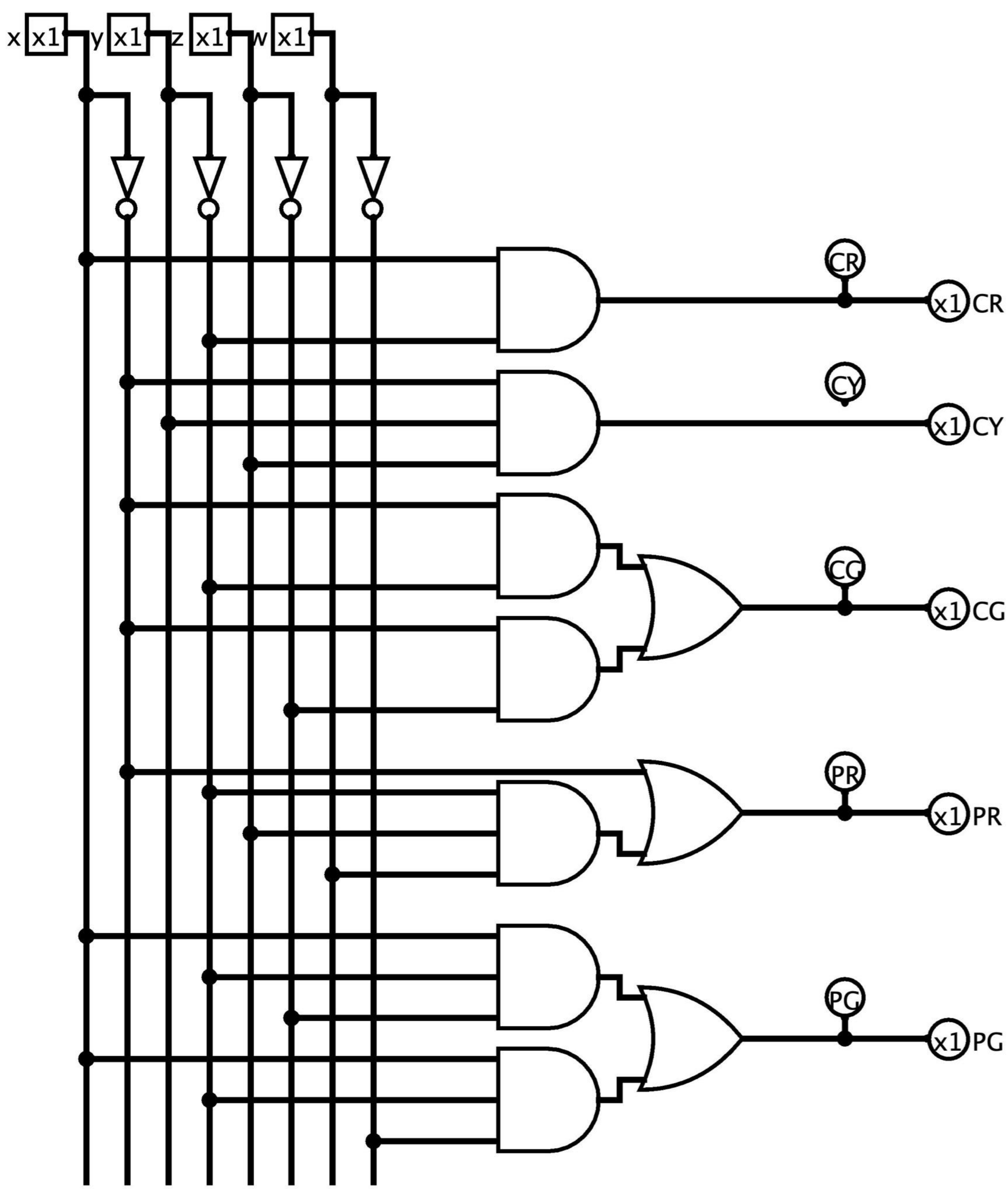
Controller Combinational Circuit:



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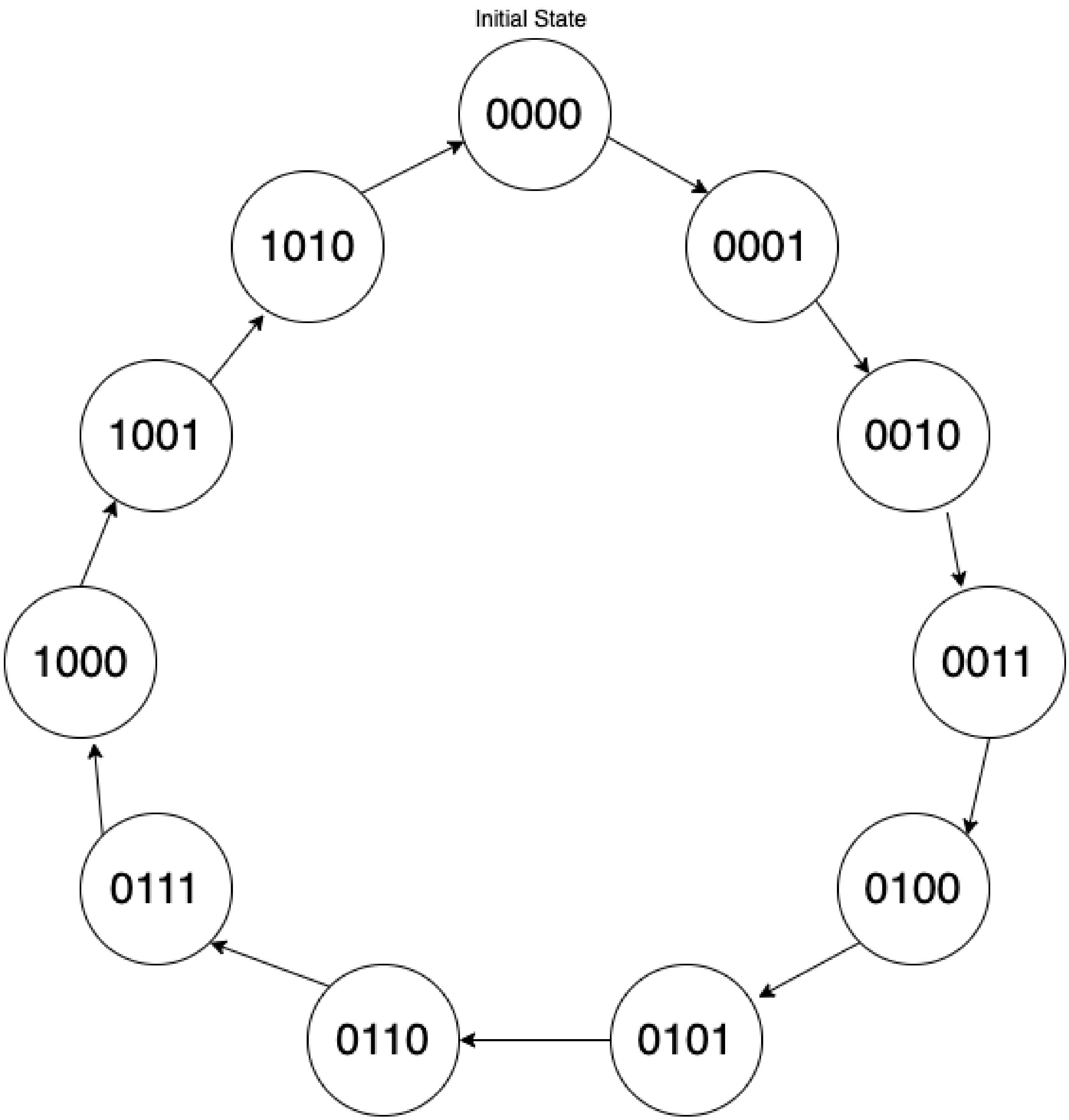
Counter

Finite State Machine:



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Counter Truth Table:

x	y	z	w	Jx	Kx	Jy	Ky	Jz	Kz	Jw	Kw
0	0	0	0	0	X	0	X	0	X	1	X
0	0	0	1	0	X	0	X	1	X	X	1
0	0	1	0	0	X	0	X	X	0	1	X
0	0	1	1	0	X	1	X	X	1	X	1
0	1	0	0	0	X	X	0	0	X	1	X
0	1	0	1	0	X	X	0	1	X	X	1
0	1	1	0	0	X	X	0	X	0	1	X
0	1	1	1	1	X	X	1	X	1	X	1
1	0	0	0	X	0	0	X	0	X	1	X
1	0	0	1	X	0	0	X	1	X	X	1
1	0	1	0	X	0	0	X	X	0	1	X
1	0	1	1	X	1	0	x	X	1	X	1

Controller Boolean Sum of Products & Simplification

Jx: x’yzw
Kx: xy’zw

Jy: x’y’zw
Ky: x’yzw

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Jz: w
Kz: w

Jw: x’y’z’w’ + x’y’zw’ + x’yz’w’ + x’yzw’ + xy’z’w’ + xy’zw’

m0	m1	m3	m2
m4	m5	m7	m6
m12	m13	m15	m14
m8	m9	m11	m10

Jw after simplification: y’w’ + x’ w’

Kw: 1

Counter Sequential Circuit: