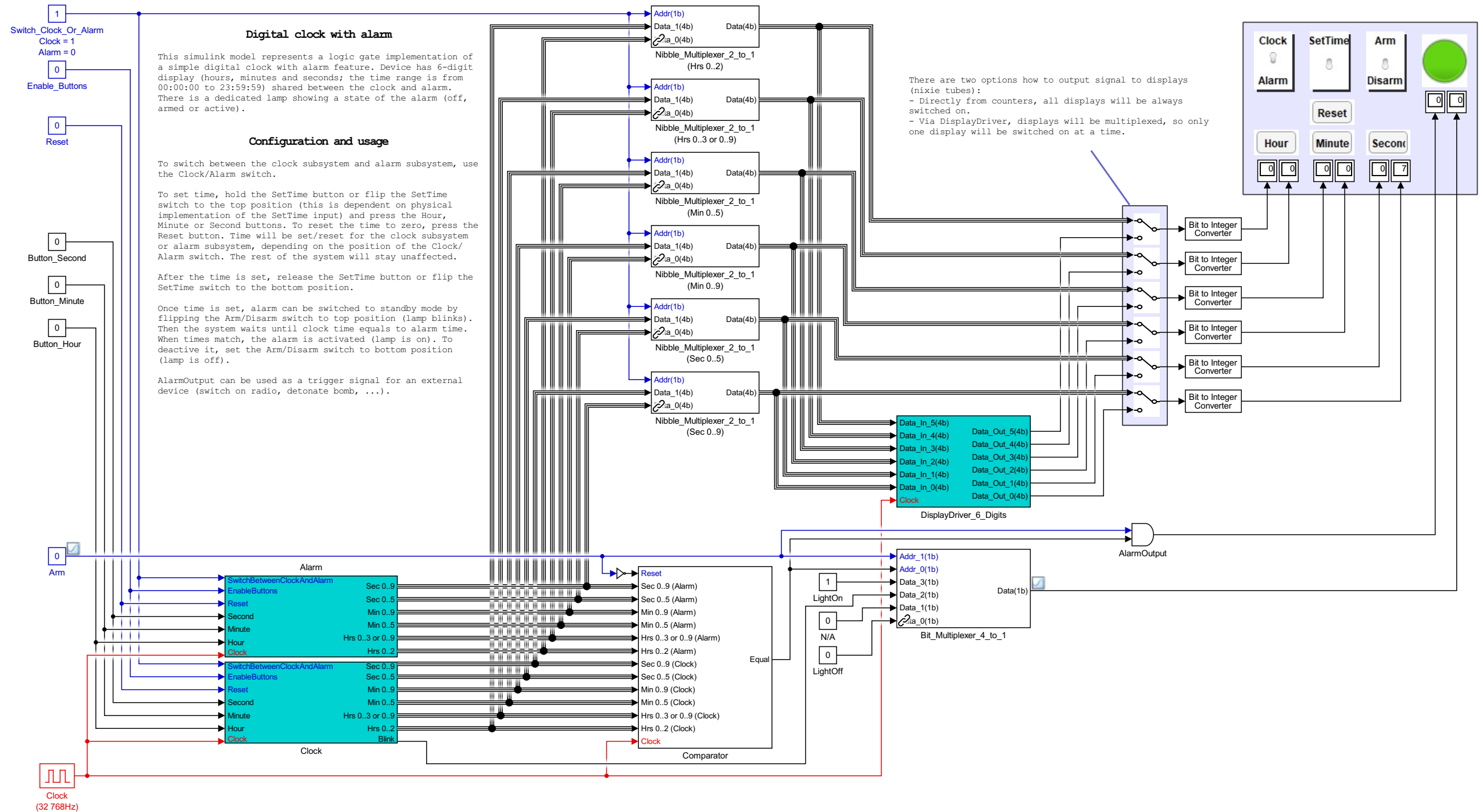
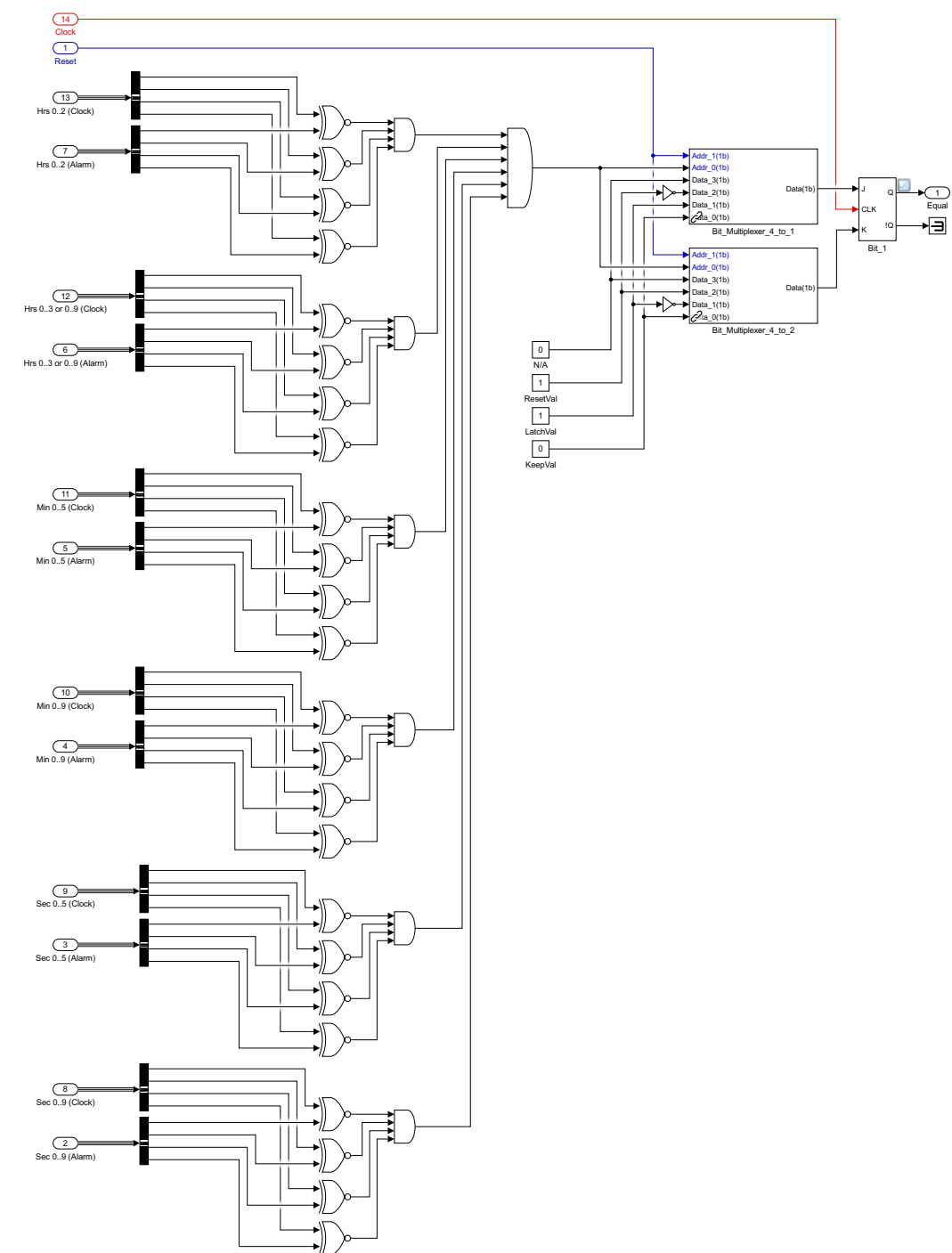


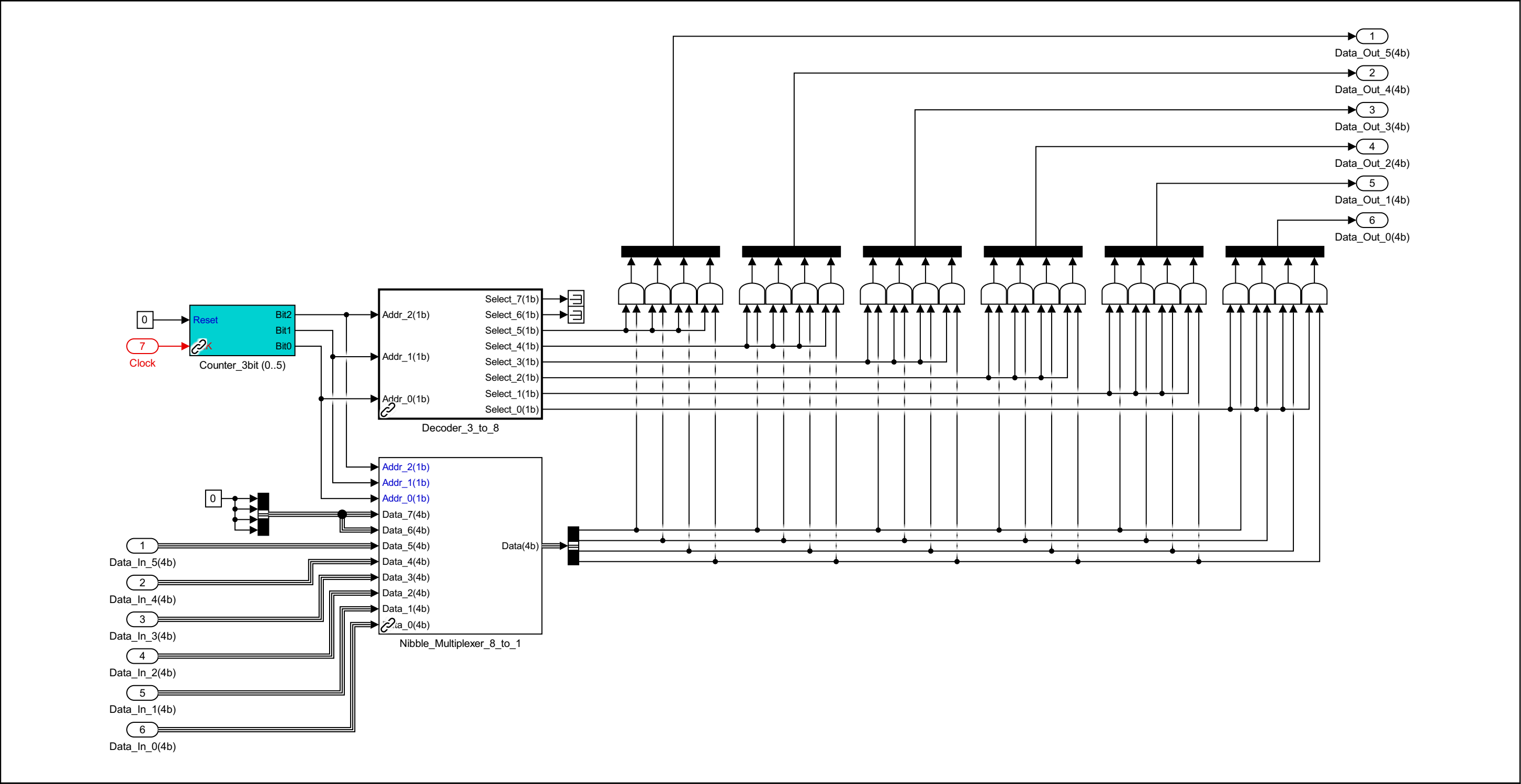
Clock



F:\Workspace\05_Projekty\Projects_Simulink\Clock\Clock.slx

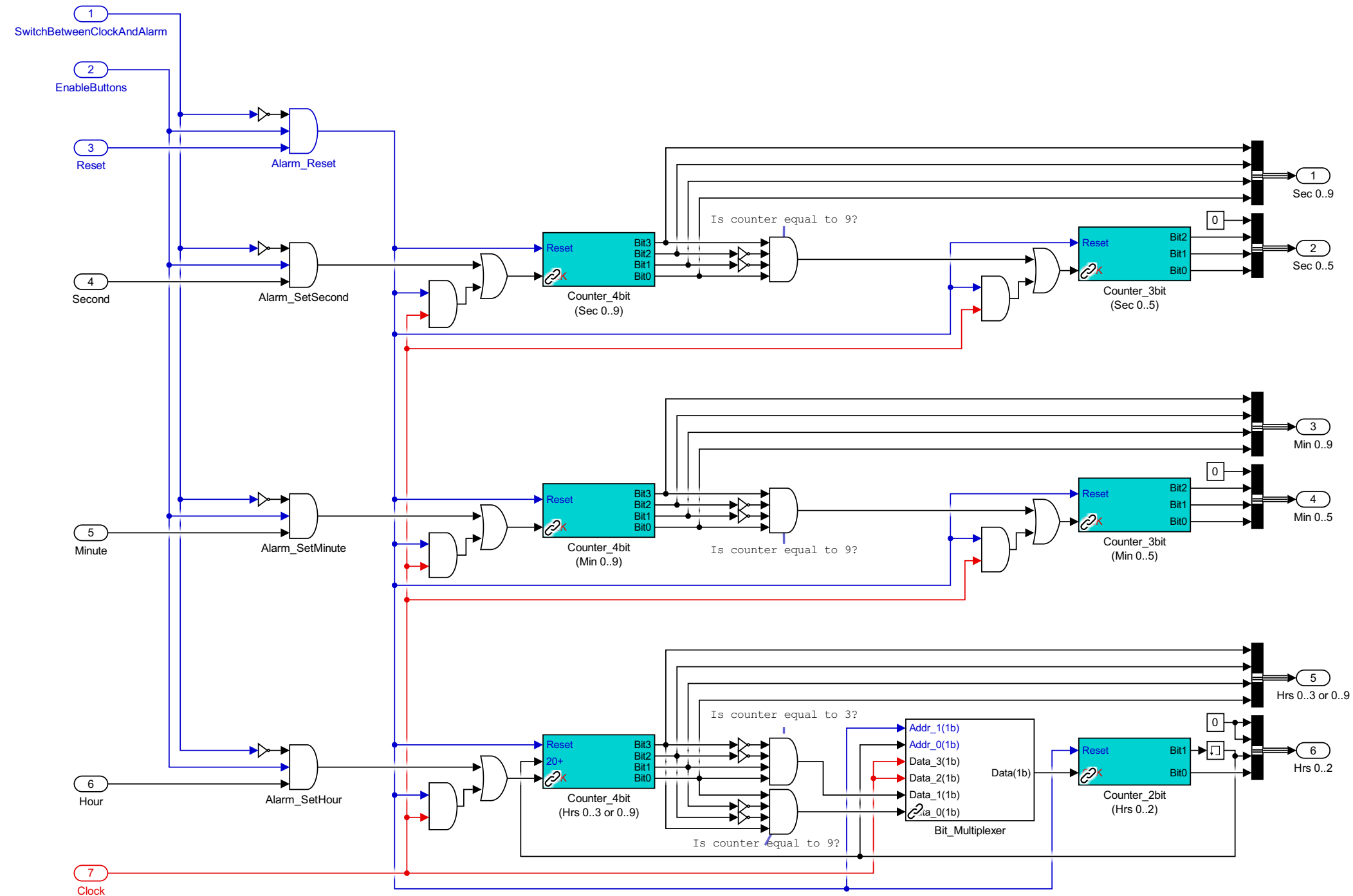


Clock/DisplayDriver_6_Digits



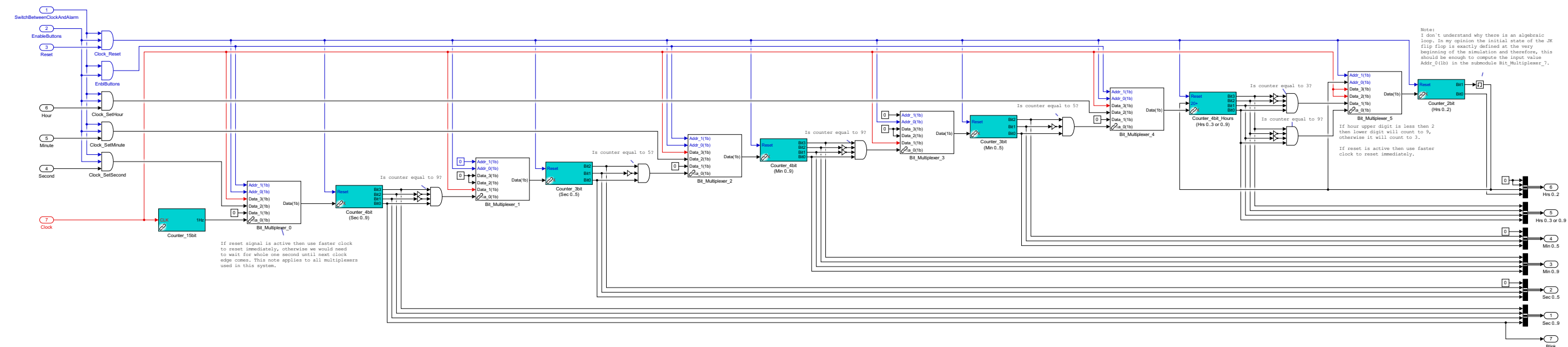
F:\Workspace\05_Projekty\Projects_Simulink\Clock\Clock.slx

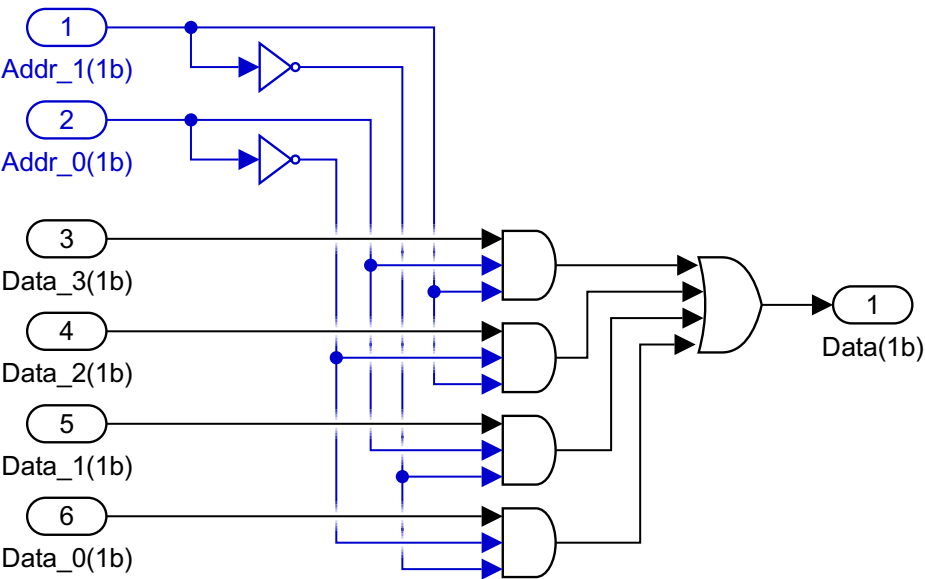
Clock/Alarm

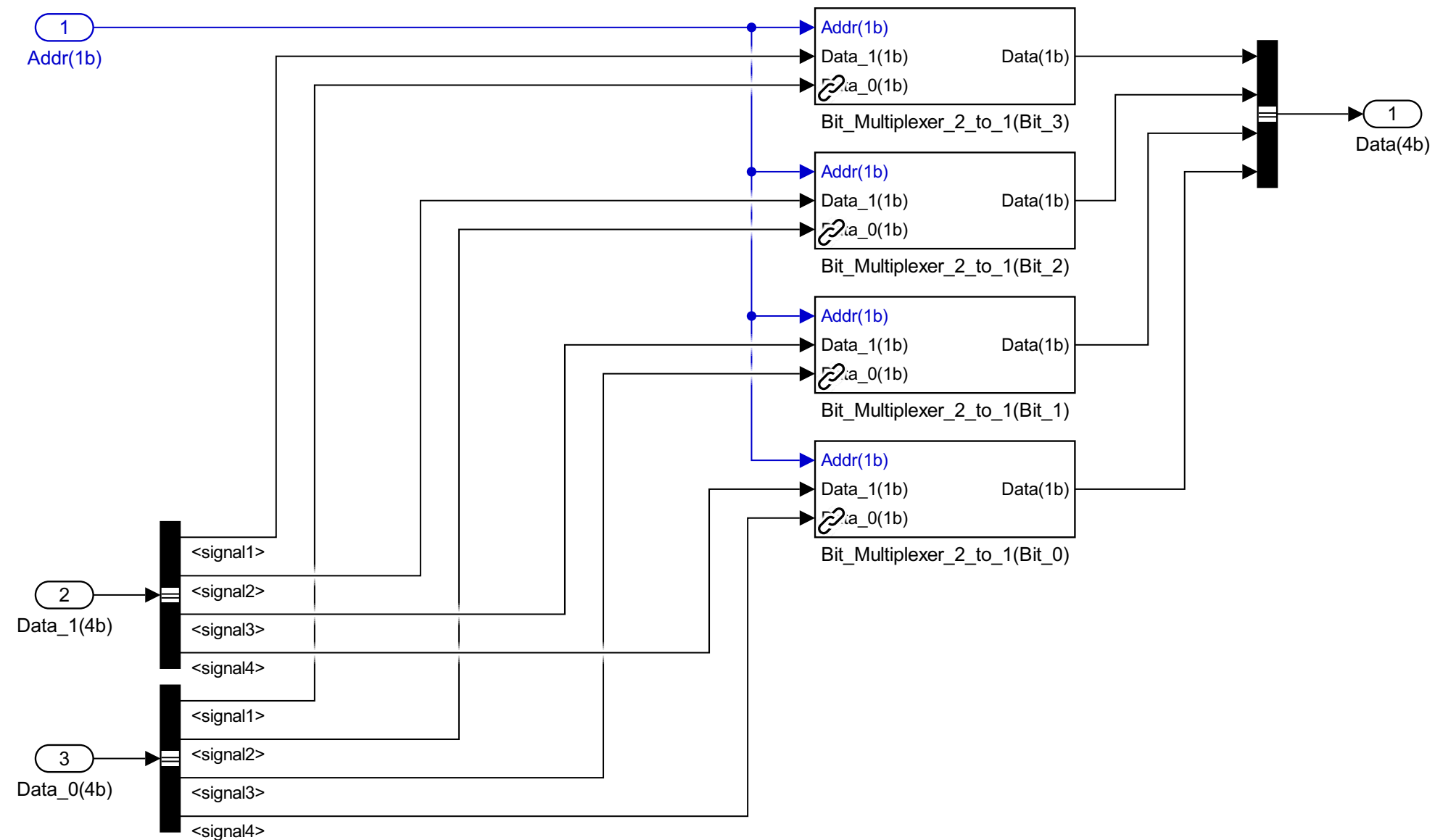


F:\Workspace\05_Projekty\Projects_Simulink\Clock\Clock.slx

Clock







3-bit counter with reset
(0 -> 1 -> 2 -> 3 -> 4 -> 5 -> 0)

Present state			Rst=0						Rst=1						Next State					
Q2	Q1	Q0	J2	K2	J1	K1	J0	K0	J2	K2	J1	K1	J0	K0	Q2	Q1	Q0	Q2	Q1	Q0
0	0	0	0	X	0	X	1	X	0	X	0	X	0	X	0	0	1	0	0	0
0	0	1	0	X	1	X	X	1	0	X	0	X	X	1	0	1	0	0	0	0
0	1	0	0	X	X	0	1	X	0	X	X	1	0	X	0	1	1	0	0	0
0	1	1	1	X	X	1	X	1	0	X	X	1	X	1	1	0	0	0	0	0
1	0	0	X	0	0	X	1	X	X	1	0	X	0	X	1	0	1	0	0	0
1	0	1	X	1	0	X	X	1	X	1	0	X	X	1	0	0	0	0	0	0
1	1	0	X	1	X	1	0	X	X	1	X	1	0	X	0	0	0	0	0	0
1	1	1	X	1	X	1	X	1	X	1	X	1	X	1	0	0	0	0	0	0

J2		Q2/Q1			
		00	01	11	10
Rst/Q0	00	0	0	X	X
	01	0	1	X	X
	11	0	0	X	X
	10	0	0	X	X

J2 = ~Rst.Q1.Q0

K2		Q2/Q1			
		00	01	11	10
Rst/Q0	00	X	X	1	0
	01	X	X	1	1
	11	X	X	1	1
	10	X	X	1	1

K2 = Rst + Q0 + ~Q2 + Q1

J1		Q2/Q1			
		00	01	11	10
Rst/Q0	00	0	X	X	0
	01	1	X	X	0
	11	0	X	X	0
	10	0	X	X	0

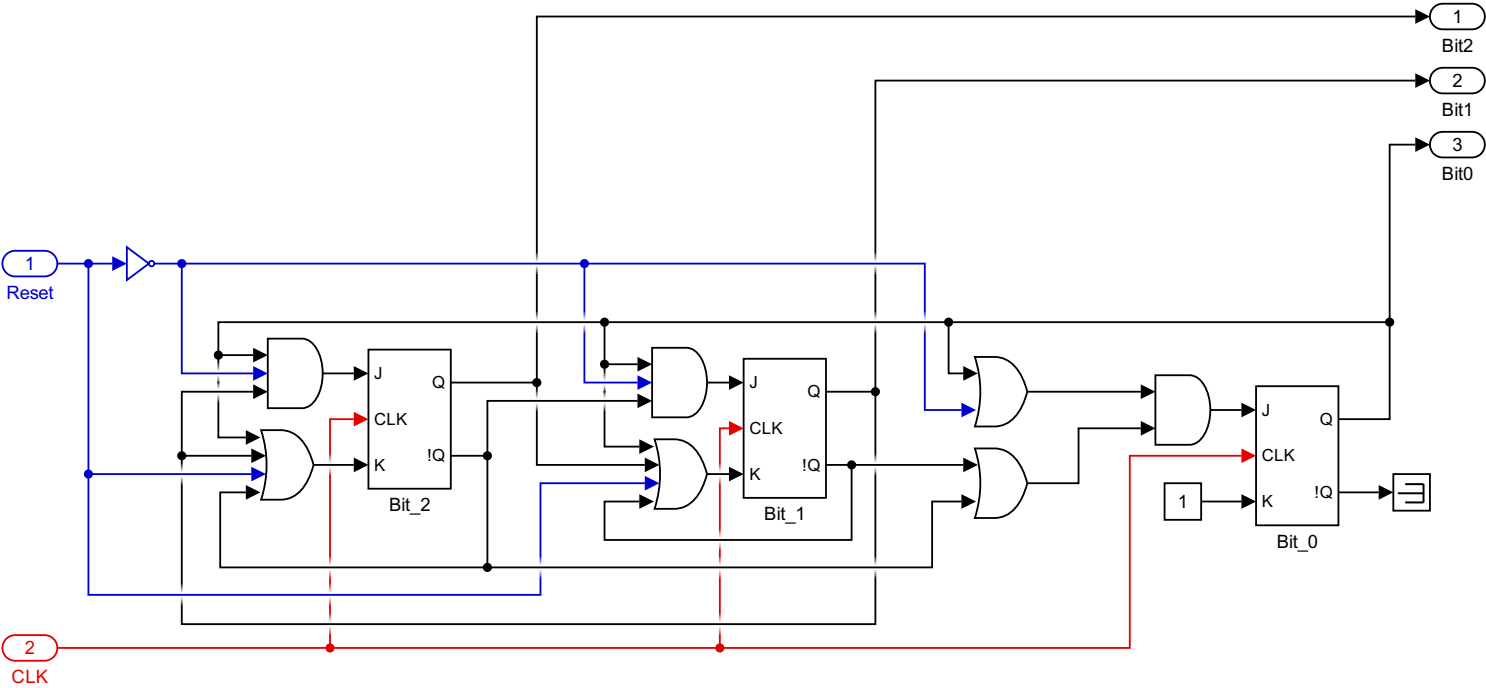
J1 = ~Rst.~Q2.Q0

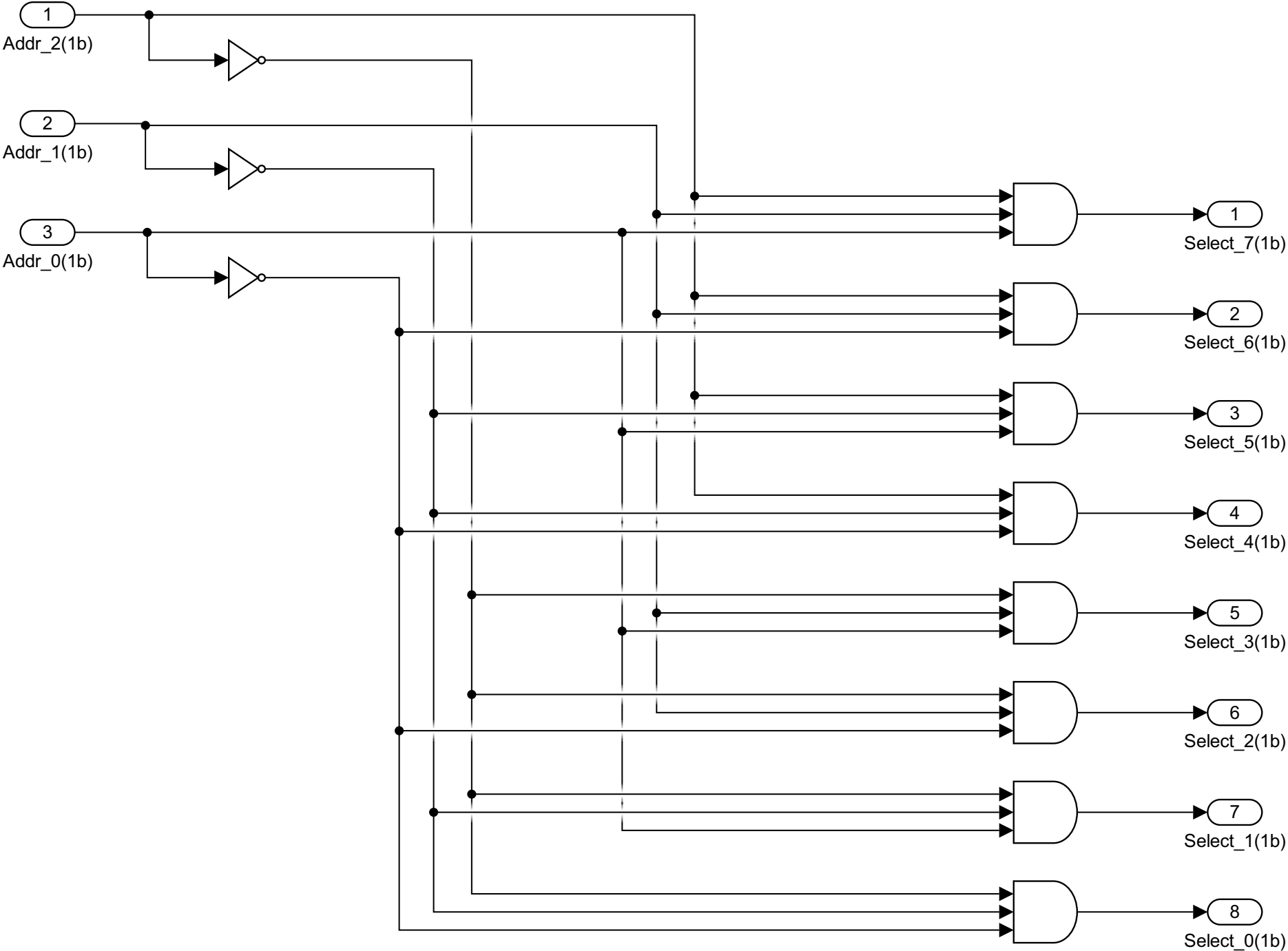
K1		Q2/Q1			
		00	01	11	10
Rst/Q0	00	X	0	1	X
	01	X	1	1	X
	11	X	1	1	X
	10	X	1	1	X

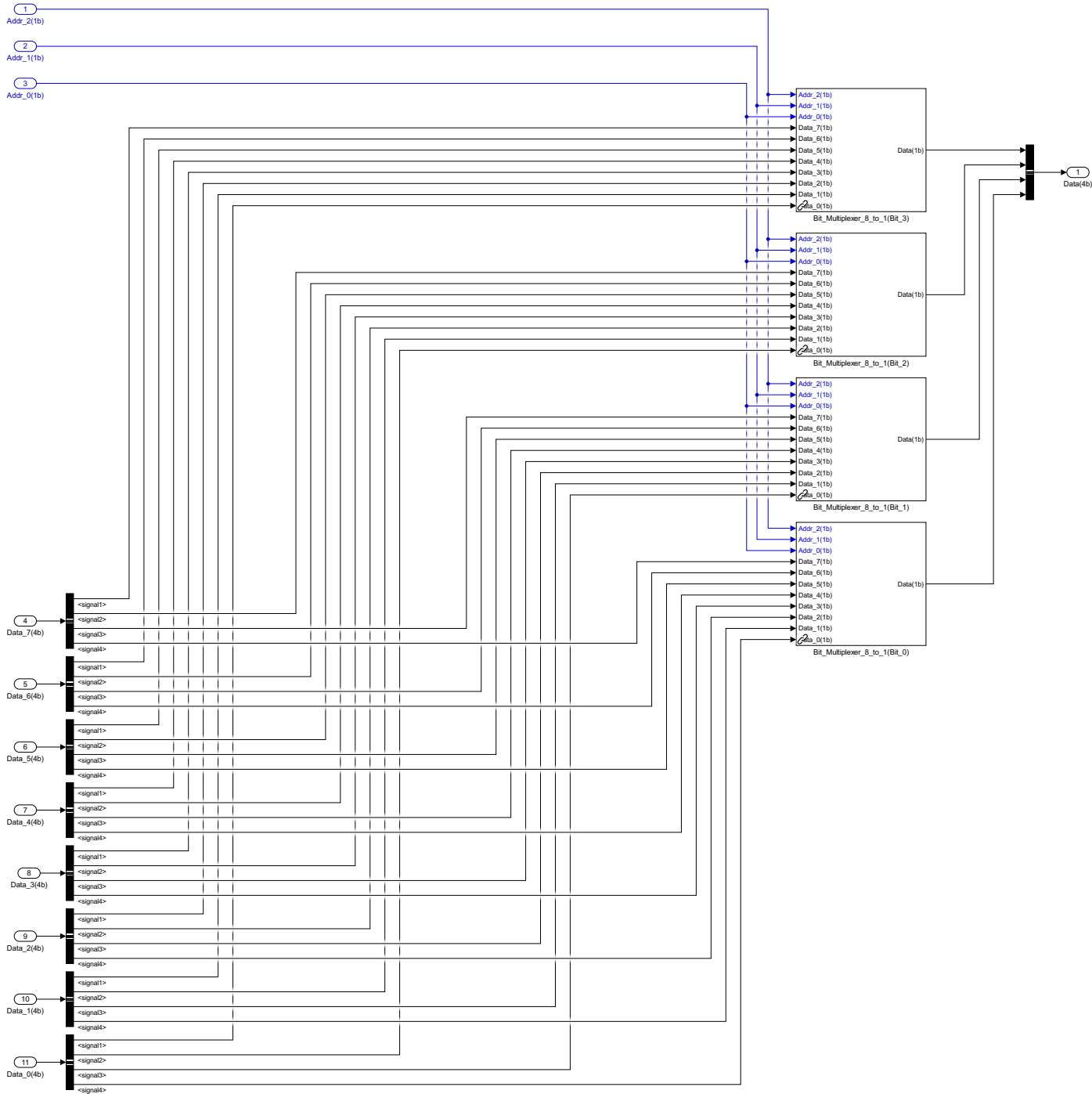
K1 = Rst + Q0 + Q2 + ~Q1

J0		Q2/Q1			
		00	01	11	10
Rst/Q0	00	1	1	0	1
	01	X	X	X	X
	11	X	X	X	X
	10	0	0	0	0

J0 = (~Q2 + ~Q1).(~Rst + Q0)
K0 = 1







2-bit counter (0..2) with reset

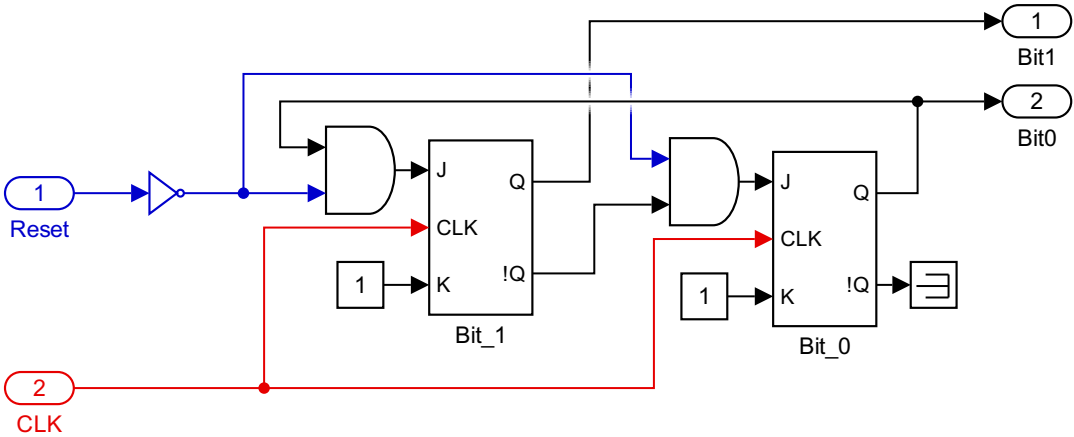
Present state		Rst=0				Rst=1				Next state			
										Rst=0		Rst=1	
Q1	Q0	J1	K1	J0	K0	J1	K1	J0	K0	Q1	Q0	Q1	Q0
0	0	0	X	1	X	0	X	0	X	0	1	0	0
0	1	1	X	X	1	0	X	X	1	1	0	0	0
1	0	X	1	0	X	X	1	0	X	0	0	0	0
1	1	X	1	X	1	X	1	X	1	0	0	0	0

J1		Q1Q0			
		00	01	11	10
Rst	0	0	1	X	X
	1	0	0	X	X

$J1 = \sim Rst.Q0$
 $K1 = 1$

J0		Q1Q0			
		00	01	11	10
Rst	0	1	X	X	0
	1	0	X	X	0

$J0 = \sim Rst.\sim Q1$
 $K0 = 1$



Clock_Lib/Counter_4bit_Hours

4-bit counter with reset
If (Hours < 20) then
(0 -> 1 -> 2 -> 3 -> 4 -> 5 -> 6 -> 7 -> 8 -> 9 -> 0)

If (Hours >= 20) then
(0 -> 1 -> 2 -> 3 -> 0)

Present state																								Next state																			
				Hours < 20										Hours >= 20										Hours < 20						Hours >= 20													
				Rst = 0					Rst = 1					Rst = 0					Rst = 1					Rst = 0			Rst = 1			Rst = 0			Rst = 1										
Q3	Q2	Q1	Q0	J3	K3	J2	K2	J1	K1	J0	K0	J3	K3	J2	K2	J1	K1	J0	K0	J3	K3	J2	K2	J1	K1	J0	K0	Q3	Q2	Q1	Q0	Q3	Q2	Q1	Q0	Q3	Q2	Q1	Q0				
0	0	0	0	0	X	0	X	0	X	1	X	0	X	0	X	0	X	0	X	1	X	0	X	0	X	0	X	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
0	0	0	1	0	X	0	X	1	X	X	1	0	X	0	X	0	X	1	X	X	1	0	X	0	X	0	X	X	0	0	1	0	0	0	0	0	0	1	0	0	0	0	
0	0	1	0	0	X	0	X	X	0	1	X	0	X	0	X	X	X	1	0	X	0	X	0	X	0	1	X	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0
0	0	1	1	0	X	1	X	X	1	X	1	0	X	0	X	X	X	1	X	1	0	X	0	X	1	X	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	X	X	0	0	X	1	X	0	X	X	1	0	X	0	X	0	X	1	0	X	0	X	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	1	0	0	X	X	0	1	X	X	1	0	X	X	1	0	X	X	1	0	X	1	0	X	1	0	X	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	0	0	1	X	X	1	X	1	X	1	0	X	X	1	X	1	0	X	1	X	1	0	X	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	1	0	1	X	X	1	X	1	X	1	0	X	X	1	X	1	0	X	1	X	1	0	X	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	X	0	0	X	0	X	1	X	X	1	0	X	0	X	X	1	0	X	0	X	X	1	0	X	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	0	X	1	0	X	0	X	X	1	X	1	0	X	0	X	X	1	X	1	0	X	1	X	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	0	0	X	1	0	X	X	1	0	X	X	1	0	X	X	1	0	X	X	1	0	X	X	1	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	0	1	X	1	0	X	X	1	X	1	X	1	0	X	1	X	1	X	1	0	X	1	X	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	X	1	X	1	0	X	0	X	X	1	X	1	0	X	0	X	X	1	0	X	X	1	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	1	0	X	1	X	1	0	X	X	1	X	1	0	X	X	1	X	1	X	1	0	X	X	1	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	0	0	X	1	X	1	X	1	0	X	X	1	X	1	X	1	0	X	X	1	X	1	X	1	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	0	X	1	X	1	X	1	X	1	0	X	X	1	X	1	0	X	X	1	X	1	X	1	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	X	1	X	1	X	1	X	1	X	1	X	1	X	1	X	1	X	1	X	1	X	1	X	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

J3		Q3/Q2/Q1							
		000	001	011	100	101	111	101	000
20+/Rst/Q0	000	0	0	0	0	0	X	X	X
	001	0	0	1	0	X	X	X	X
	011	0	0	0	0	X	X	X	X
	010	0	0	0	0	X	X	X	X
	100	0	0	0	0	X	X	X	X
	111	0	0	0	0	X	X	X	X
	101	0	0	0	0	X	X	X	X
	100	0	0	0	0	X	X	X	X

$J3 = \sim(20+) \cdot \sim Rst \cdot Q0 \cdot \sim Q3 \cdot Q2 \cdot Q1$

K3		Q3/Q2/Q1							
		000	001	011	100	101	111	101	000
20+/Rst/Q0	000	X	X	X	X	1	1	1	0
	001	X	X	X	X	1	1	1	1
	011	X	X	X	X	1	1	1	1
	010	X	X	X	X	1	1	1	1
	100	X	X	X	X	1	1	1	1
	111	X	X	X	X	1	1	1	1
	101	X	X	X	X	1	1	1	1
	100	X	X	X	X	1	1	1	1

$K3 = (20+) + Rst + Q0 + \sim Q3 + Q2 + Q1$

J2		Q3/Q2/Q1							
		000	001	011	100	101	111	101	000
20+/Rst/Q0	000	0	0	X	X	X	X	0	0
	001	0	1	X	X	X	X	0	0
	011	0	0	X	X	X	X	0	0
	010	0	0	X	X	X	X	0	0
	100	0	0	X	X	X	X	0	0
	111	0	0	X	X	X	X	0	0
	101	0	0	X	X	X	X	0	0
	100	0	0	X	X	X	X	0	0

$J2 = \sim(20+) \cdot \sim Rst \cdot Q0 \cdot \sim Q3 \cdot Q2 \cdot Q1$

K2		Q3/Q2/Q1							
		000	001	011	100	101	111	101	000
20+/Rst/Q0	000	X	X	0	0	1	1	X	X
	001	X	X	1	0	1	1	X	X
	011	X	X	1	1	1	1	X	X
	010	X	X	1	1	1	1	X	X
	100	X	X	1	1	1	1	X	X
	111	X	X	1	1	1	1	X	X
	101	X	X	1	1	1	1	X	X
	100	X	X	1	1	1	1	X	X

$K2 = \sim(20+) \cdot \sim Rst \cdot Q0 \cdot \sim Q3 \cdot Q2 \cdot Q1 + Rst + (20+) + Q3$

J1		Q3/Q2/Q1							
		000	001	011	100	101	111	101	000
20+/Rst/Q0	000	0	X	X	0	0	X	X	0
	001	1	X	X	1	0	X	X	0
	011	0	X	X	0	0	X	X	0
	010	0	X	X	0	0	X	X	0
	100	0	X	X	0	0	X	X	0
	111	0	X	X	0	0	X	X	0
	101	1	X	X	0	0	X	X	0
	100	0	X	X	0	0	X	X	0

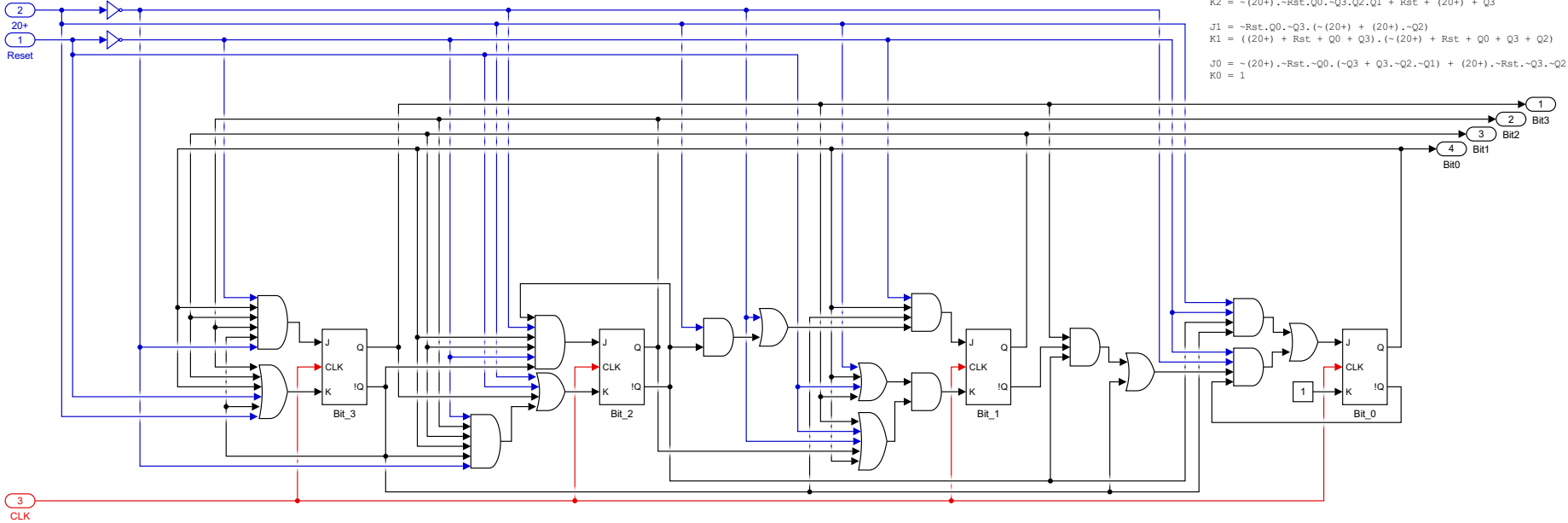
$J1 = \sim(20+) \cdot \sim Rst \cdot Q0 \cdot \sim Q3 + (20+) \cdot \sim Rst \cdot Q0 \cdot \sim Q3 \cdot Q2 = \sim Rst \cdot Q0 \cdot \sim Q3 \cdot (\sim(20+) + (20+) \cdot Q2)$

K1		Q3/Q2/Q1							
		000	001	011	100	101	111	101	000
20+/Rst/Q0	000	X	0	0	X	X	1	1	X
	001	X	1	1	X	X	1	1	X
	011	X	1	1	X	X	1	1	X
	010	X	1	1	X	X	1	1	X
	100	X	1	1	X	X	1	1	X
	111	X	1	1	X	X	1	1	X
	101	X	1	1	X	X	1	1	X
	100	X	0	1	X	X	1	1	X

$K1 = ((20+) + Rst + Q0 + Q3) \cdot (\sim(20+) + Rst + Q0 + Q3 + Q2)$

J0		Q3/Q2/Q1							
		000	001	011	100	101	111	101	000
20+/Rst/Q0	000	1	1	1	1	0	0	0	1
	001	X	X	X	X	X	X	X	X
	011	X	X	X	X	X	X	X	X
	010	0	0	0	0	0	0	0	0
	100	0	0	0	0	0	0	0	0
	111	X	X	X	X	X	X	X	X
	101	X	X	X	X	X	X	X	X
	100	1	1	0	0	0	0	0	0

$J0 = \sim(20+) \cdot \sim Rst \cdot \sim Q0 \cdot (\sim Q3 + Q3 \cdot \sim Q2 \cdot \sim Q1) + (20+) \cdot \sim Rst \cdot \sim Q3 \cdot \sim Q2$
 $K0 = 1$



4-bit counter with reset
(0 -> 1 -> 2 -> 3 -> 4 -> 5 -> 6 -> 7 -> 8 -> 9 -> 0)

Present state				Rst=0								Rst=1								Next state				
Q3	Q2	Q1	Q0	J3	K3	J2	K2	J1	K1	J0	K0	J3	K3	J2	K2	J1	K1	J0	K0	Q3	Q2	Q1	Q0	
0	0	0	0	0	X	0	X	0	X	1	X	0	X	0	X	0	X	0	X	0	0	1	0	0
0	0	0	1	0	X	0	X	1	X	X	1	0	X	0	X	0	X	X	1	0	0	1	0	0
0	0	1	0	0	X	0	X	X	0	1	X	0	X	0	X	X	1	0	X	0	1	0	0	0
0	0	1	1	0	X	1	X	X	1	X	1	0	X	0	X	X	1	X	1	0	1	0	0	0
0	1	0	0	0	X	X	0	0	X	1	X	0	X	X	1	0	X	0	X	0	1	0	0	0
0	1	0	1	0	X	X	0	1	X	X	1	0	X	X	1	0	X	X	1	0	1	0	0	0
0	1	1	0	0	X	X	0	X	0	1	X	0	X	X	1	X	1	0	X	0	1	1	0	0
0	1	1	1	1	X	X	1	X	1	X	1	0	X	X	1	X	1	X	1	0	1	1	0	0
1	0	0	0	X	0	0	X	0	X	1	X	X	1	0	X	0	X	X	1	0	0	0	0	0
1	0	0	1	X	0	0	X	0	X	1	X	X	1	0	X	0	X	X	1	0	0	0	0	0
1	0	1	0	X	1	0	X	X	1	0	X	X	1	0	X	X	1	0	X	0	0	0	0	0
1	0	1	1	X	1	0	X	X	1	X	1	X	1	0	X	X	1	X	1	0	0	0	0	0
1	1	0	0	X	1	X	1	0	X	0	X	X	1	X	1	0	X	0	X	0	0	0	0	0
1	1	0	1	X	1	X	1	0	X	X	1	X	1	X	1	0	X	X	1	0	0	0	0	0
1	1	1	0	X	1	X	1	X	1	0	X	X	1	X	1	X	1	0	X	0	0	0	0	0
1	1	1	1	1	X	1	X	1	X	1	X	1	X	1	X	1	X	1	X	1	0	0	0	0

J3

Q3/Q2/Q1

	000	001	011	010	110	111	101	100	
Rst/Q0	00	0	0	0	0	x	x	x	x
	01	0	0	1	0	x	x	x	x
	11	0	0	0	0	x	x	x	x
	10	0	0	0	0	x	x	x	x

J3 = ~Rst.Q0.~Q3.Q2.Q1

K3

Q3/Q2/Q1

	000	001	011	010	110	111	101	100	
Rst/Q0	10	x	x	x	x	1	1	1	0
	01	x	x	x	x	1	1	1	1
	11	x	x	x	x	1	1	1	1
	10	x	x	x	x	1	1	1	1

K3 = Rst + Q0 + ~Q3 + Q2 + Q1

J2

Q3/Q2/Q1

	000	001	011	010	110	111	101	100	
Rst/Q0	00	0	0	x	x	x	x	0	0
	01	0	1	x	x	x	x	0	0
	11	0	0	x	x	x	x	0	0
	10	0	0	x	x	x	x	0	0

J2 = ~Rst.Q0.~Q3.~Q2.Q1

K2

Q3/Q2/Q1

	000	001	011	010	110	111	101	100	
Rst/Q0	01	x	x	0	0	1	1	x	x
	01	x	x	1	0	1	1	x	x
	11	x	x	1	1	1	1	x	x
	10	x	x	1	1	1	1	x	x

K2 = ~Rst.Q0.~Q3.Q2.Q1 + Rst + Q3

J1

Q3/Q2/Q1

	000	001	011	010	110	111	101	100	
Rst/Q0	00	0	x	x	0	0	x	x	0
	01	1	x	x	1	0	x	x	0
	11	0	x	x	0	0	x	x	0
	10	0	x	x	0	0	x	x	0

J1 = ~Rst.Q0.~Q3

K1

Q3/Q2/Q1

	000	001	011	010	110	111	101	100	
Rst/Q0	10	x	0	0	x	x	1	1	x
	01	x	1	1	x	x	1	1	x
	11	x	1	1	x	x	1	1	x
	10	x	1	1	x	x	1	1	x

K1 = Rst + Q0 + Q3

J0

Q3/Q2/Q1

	000	001	011	010	110	111	101	100	
Rst/Q0	00	1	1	1	1	0	0	0	1
	01	x	x	x	x	x	x	x	x
	11	x	x	x	x	x	x	x	x
	10	0	0	0	0	0	0	0	0

J0 = ~Rst.~Q0.~Q3 + ~Rst.~Q0.Q3.~Q2.~Q1 = ~Rst.~Q0.(~Q3 + Q3.~Q2.~Q1)

K3 = Rst + Q0 + ~Q3 + Q2 + Q1

J3 = ~Rst.Q0.~Q3.Q2.Q1

J2 = ~Rst.Q0.~Q3.~Q2.Q1

K2 = ~Rst.Q0.~Q3.Q2.Q1 + Rst + Q3

J1 = ~Rst.Q0.~Q3

K1 = Rst + Q0 + Q3

J0 = ~Rst.~Q0.~Q3 + ~Rst.~Q0.Q3.~Q2.~Q1 = ~Rst.~Q0.(~Q3 + Q3.~Q2.~Q1)

K0 = 1

J0 = ~Rst.~Q0.~Q3 + ~Rst.~Q0.Q3.~Q2.~Q1 = ~Rst.~Q0.(~Q3 + Q3.~Q2.~Q1)

K0 = 1

