

Counting Up + Carry En

	Q3	Q2	Q1	Q0	DOWN	CEN	D3	D2	D1	D0
0	0	0	0	0	1	0	0	0	0	1
1	0	0	0	1	0	1	0	0	1	0
2	0	0	1	0	0	1	0	0	1	1
3	0	0	1	1	0	1	0	1	0	0
4	0	1	0	0	0	1	0	1	0	1
5	0	1	0	1	0	1	0	1	1	0
6	0	1	1	0	0	1	0	1	1	1
7	0	1	1	1	0	1	1	0	0	1
8	1	0	0	0	0	1	1	0	0	1
9	1	0	0	1	0	1	0	0	0	0

Counting Down + Carry Enabled

	Q3	Q2	Q1	Q0	DOWN	CEN	D3	D2	D1	D0
0	0	0	0	0	1	1	1	0	0	1
1	0	0	0	1	1	1	1	0	0	0
2	0	0	0	0	1	1	0	1	1	1
3	0	1	1	1	1	1	0	1	1	0
4	0	1	1	0	1	1	0	1	0	1
5	0	1	0	1	1	1	0	1	0	0
6	0	1	0	0	1	1	0	0	1	1
7	0	1	0	1	1	1	0	0	1	0
8	1	0	1	1	1	1	0	0	0	1
9	1	0	0	1	1	1	0	0	0	0

Counting Up + Carry Disabled

	Q3	Q2	Q1	Q0	DOWN	CEN	D3	D2	D1	D0
0	0	0	0	0	1	0	0	0	0	0
1	0	0	0	1	1	0	1	0	0	1
2	0	0	0	0	1	0	1	0	0	0
3	0	1	1	1	1	0	0	1	1	1
4	0	1	1	0	1	0	0	1	1	0
5	0	1	0	1	1	0	0	1	0	1
6	0	1	0	0	1	0	0	1	0	0
7	0	1	0	1	1	0	0	1	0	1
8	1	0	0	0	1	0	0	1	0	0
9	1	0	0	1	1	0	0	1	0	1

Counting Up + Carry Disabled

	Q3	Q2	Q1	Q0	DOWN	CEN	D3	D2	D1	D0
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	0	0	1
2	0	0	1	0	0	0	0	0	1	0
3	0	0	1	1	0	0	0	0	1	1
4	0	1	0	0	0	0	1	0	0	0
5	0	1	0	1	0	0	1	0	0	1
6	0	1	1	0	0	0	1	1	0	0
7	0	1	1	1	0	0	1	1	0	1
8	1	0	0	0	0	1	0	0	0	0
9	1	0	0	1	0	1	0	0	0	1

D0

CEN = TRUE

Q1

DOWN = FALSE

D0-0	Q3/Q2				
Q1/Q0	00	01	11	10	
00	T	T	X	T	
01	F	F	X	F	
11	F	F	X	X	
10	T	T	X	X	

DOWN = TRUE

D0-1	Q3/Q2				
Q1/Q0	00	01	11	10	
00	T	T	X	T	
01	F	F	X	F	
11	F	F	X	X	
10	T	T	X	X	

$$CQ_0 + \bar{C}Q_0 = 0$$

CEN = FALSE

Q0

D0-0	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	F	X	F	
01	T	T	X	T	
11	T	T	X	X	
10	F	F	X	X	

D0-1	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	F	X	F	
01	T	T	X	T	
11	T	T	X	X	
10	F	F	X	X	

D2

CEN = TRUE

Q1

D1-0	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	F	X	F	
01	T	T	X	F	
11	F	F	X	X	
10	T	T	X	X	

D1-1	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	T	X	T	
01	F	F	X	F	
11	T	T	X	X	
10	F	F	X	X	

$$C\bar{D}(Q_3\bar{Q}_1Q_0 + Q_1Q_0) + C\bar{D}(Q_1Q_0 + Q_3\bar{Q}_0 + Q_2\bar{Q}_0) + \bar{C}Q_1$$

$$= C(\bar{D}(Q_3\bar{Q}_1Q_0 + Q_1Q_0) + D(Q_1Q_0 + Q_3\bar{Q}_0 + Q_2\bar{Q}_0) + \bar{C}Q_1)$$

CEN = FALSE

Q0

D1-0	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	F	X	F	
01	F	F	X	F	
11	T	T	X	X	
10	T	T	X	X	

D1-1	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	F	X	F	
01	F	F	X	F	
11	T	T	X	X	
10	T	T	X	X	

CEN = TRUE

Q1

D2-0	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	T	X	F	
01	F	T	X	F	
11	T	T	X	X	
10	F	T	X	X	

D2-1	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	T	X	F	
01	F	T	X	F	
11	T	T	X	X	
10	F	T	X	X	

$$C\bar{D}(Q_2\bar{Q}_1\bar{Q}_0 + \bar{Q}_2Q_1Q_0) + C\bar{D}(Q_2Q_1Q_0 + Q_3\bar{Q}_2\bar{Q}_0) + C(Q_3Q_1Q_0 + \bar{C}Q_2)$$

$$C(\bar{D}(Q_2\bar{Q}_1\bar{Q}_0 + \bar{Q}_2Q_1Q_0) + D(Q_2Q_1Q_0 + Q_3\bar{Q}_2\bar{Q}_0) + Q_2(Q_1Q_0 + Q_1Q_0)) + \bar{C}Q_2$$

CEN = FALSE

Q0

D2-1	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	T	X	F	
01	F	T	X	F	
11	F	T	X	X	
10	F	T	X	X	

D2-1	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	T	X	F	
01	F	T	X	F	
11	F	T	X	X	
10	F	T	X	X	

D3

CEN = TRUE

Q1

D3-0	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	F	X	T	
01	F	F	X	F	
11	F	T	X	X	
10	F	F	X	X	

D3-1	Q3/Q2				
Q1/Q0	00	01	11	10	
00	T	F	X	F	
01	F	F	X	T	
11	F	F	X	X	
10	F	F	X	X	

$$C\bar{D}(Q_3Q_1Q_0 + Q_3\bar{Q}_0) + C\bar{D}(Q_3\bar{Q}_2\bar{Q}_1\bar{Q}_0 + Q_3\bar{Q}_1Q_0) + \bar{C}Q_3$$

$$C(\bar{D}(Q_3Q_1Q_0 + Q_3\bar{Q}_0) + D(Q_3\bar{Q}_2\bar{Q}_1\bar{Q}_0 + Q_3\bar{Q}_1Q_0)) + \bar{C}Q_3$$

CEN = FALSE

Q0

D3-1	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	F	X	T	
01	F	F	X	T	
11	F	F	X	X	
10	F	F	X	X	

D3-1	Q3/Q2				
Q1/Q0	00	01	11	10	
00	F	F	X	T	
01	F	F	X	T	
11	F	F	X	X	
10	F	F	X	X	

C = when a and up 0 and down

$$C = (\bar{D}(Q_3\bar{Q}_2\bar{Q}_1\bar{Q}_0) + D(Q_3\bar{Q}_2\bar{Q}_1\bar{Q}_0))$$