

SEL 454

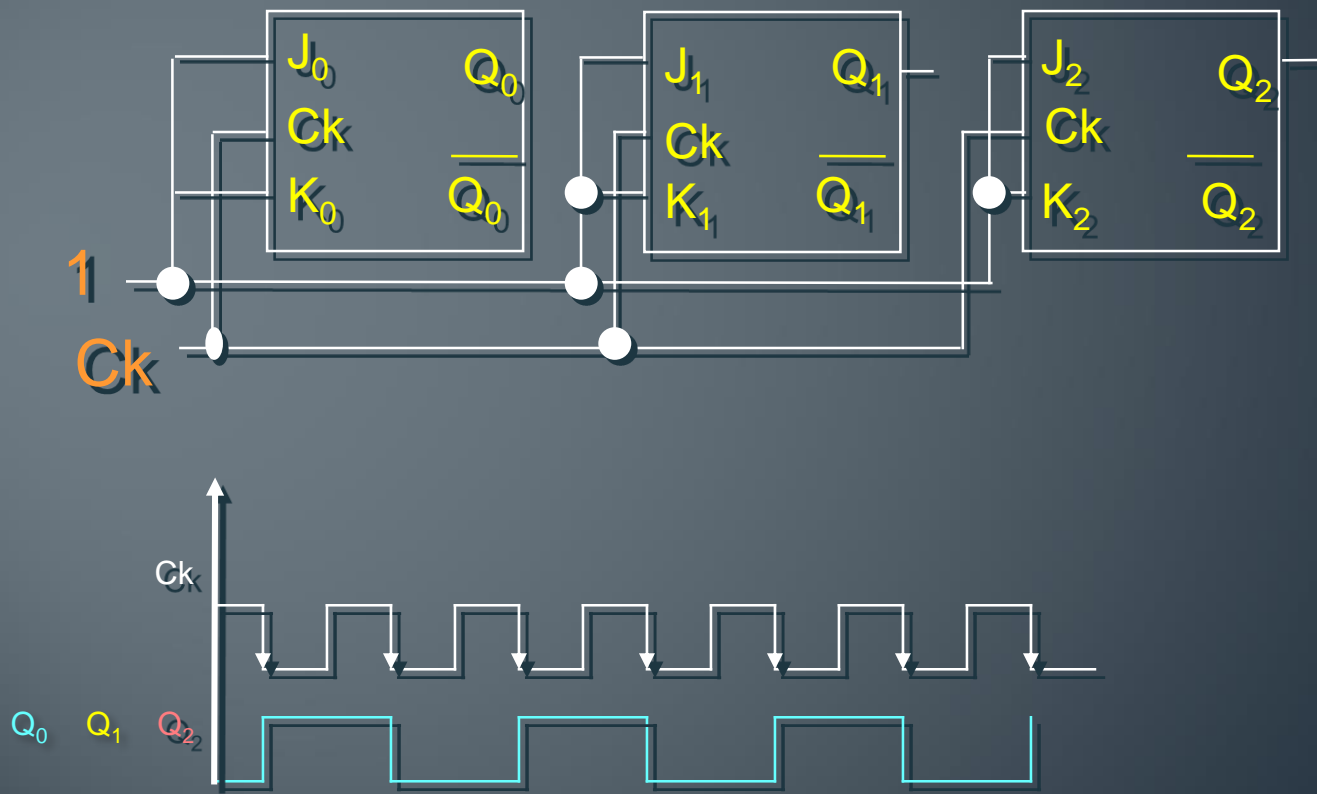
Introdução aos Sistemas Digitais

CONTADORES BINÁRIOS

Prof. Homero Schiabel

CONTADOR SÍNCRONO

Contador Síncrono de Pulsos



Contador Síncrono de Pulsos

Pulsos Ck	Q ₂	Q ₁	Q ₀	J ₂	K ₂	J ₁	K ₁	J ₀	K ₀
0	0	0	0	0	X	0	X	1	X
1	0	0	1	0	X	1	X	X	1
2	0	1	0	0	X	X	0	1	X
3	0	1	1	1	X	X	1	X	1
4	1	0	0	X	0	0	X	1	X
5	1	0	1	X	0	1	X	X	1
6	1	1	0	X	0	X	0	1	X
7	1	1	1	X	1	X	1	X	1

J	K	Q *
0	0	Q
0	1	0
1	0	1
1	1	<u>Q</u>

	Q_2Q_1			
Q_0	00	01	11	10
0	0	0	X	X
1	0	1	X	X

J_2

	Q_2Q_1			
Q_0	00	01	11	10
0	0	X	X	0
1	1	X	X	1

J_1

	Q_2Q_1			
Q_0	00	01	11	10
0	1	1	1	1
1	X	X	X	X

J_0

	Q_2Q_1			
Q_0	00	01	11	10
0	X	X	0	0
1	X	X	1	0

K_2

	Q_2Q_1			
Q_0	00	01	11	10
0	X	0	0	X
1	X	1	1	X

K_1

	Q_2Q_1			
Q_0	00	01	11	10
0	X	X	X	X
1	1	1	1	1

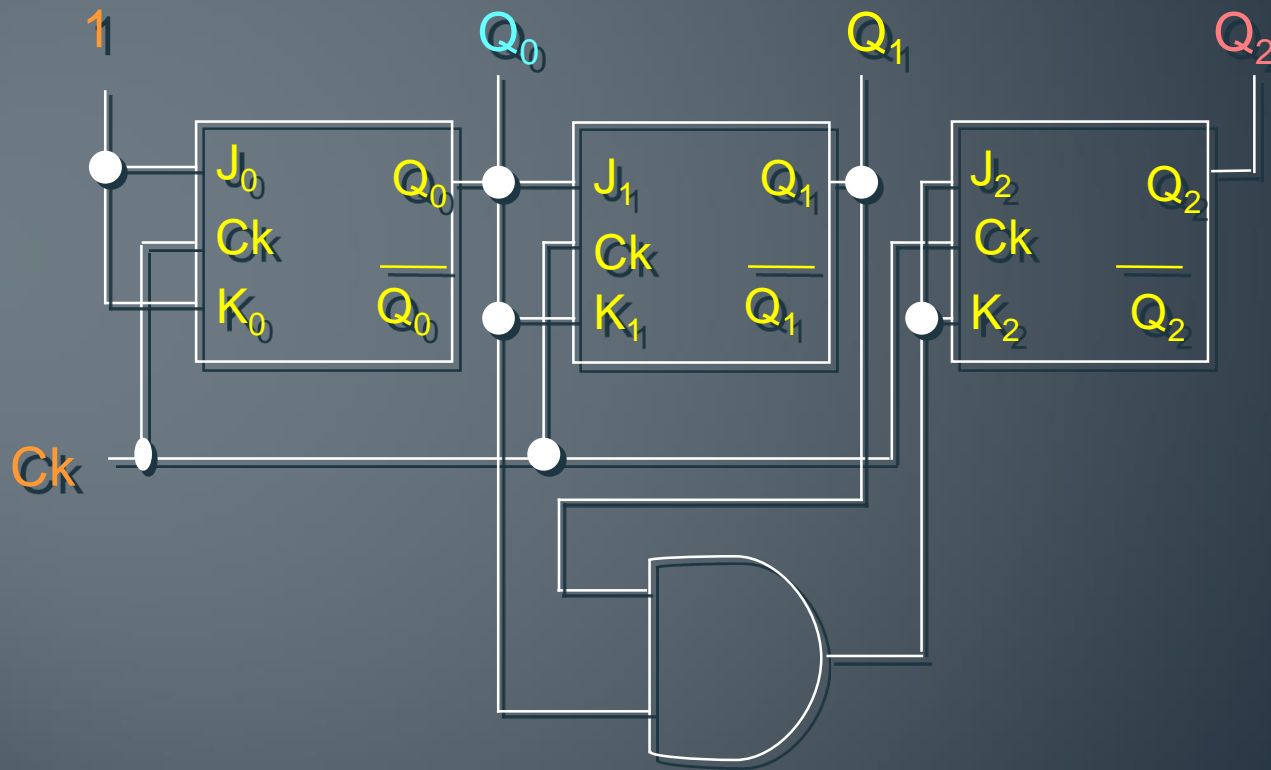
K_0

$$J_2 = K_2 = Q_1Q_0$$

$$J_1 = K_1 = Q_0$$

$$J_0 = K_0 = 1$$

Contador Binário Síncrono de 3 bits



Contador Síncrono de Qualquer Sequência

Número	Q ₃	Q ₂	Q ₁	Q ₀
0	0	0	0	0
1	0	0	0	1
3	0	0	1	1
7	0	1	1	1
15	1	1	1	1
14	1	1	1	0
12	1	1	0	0
8	1	0	0	0

J ₃	K ₃	J ₂	K ₂	J ₁	K ₁	J ₀	K ₀
0	X	0	X	0	X	1	X
0	X	0	X	1	X	X	0
0	X	1	X	X	0	X	0
1	X	X	0	X	0	X	0
X	0	X	0	X	0	X	1
X	0	X	0	X	1	0	X
X	0	X	1	0	X	0	X
X	1	0	X	0	X	0	X

J₃

Q_3Q_2	00	01	11	10
00	0	.	X	X
01	0	.	.	.
11	0	1	X	.
10	.	.	X	.

J₂

Q_3Q_2	00	01	11	10
00	0	.	X	0
01	0	.	.	.
11	1	X	X	.
10	.	.	X	.

J₁

Q_3Q_2	00	01	11	10
00	0	.	0	0
01	1	.	.	.
11	X	X	X	.
10	.	.	X	.

J₀

Q_3Q_2	00	01	11	10
00	1	.	0	0
01	X	.	.	.
11	X	X	X	.
10	.	.	0	.

K₃

Q_3Q_2	00	01	11	10
00	X	.	0	1
01	X	.	.	.
11	X	X	0	.
10	.	.	0	.

K₂

Q_3Q_2	00	01	11	10
00	X	.	1	X
01	X	.	.	.
11	X	0	0	.
10	.	.	0	.

K₁

Q_3Q_2	00	01	11	10
00	X	.	X	X
01	X	.	.	.
11	0	0	0	.
10	.	.	1	.

K₀

Q_3Q_2	00	01	11	10
00	X	.	X	X
01	0	.	.	.
11	0	0	1	.
10	.	.	X	.

E os demais estados?

1. Pode-se considerar como irrelevantes;
2. Pode-se “forçar” a ida para um estado pré-definido ou o reinício da contagem.

Ex.: forçando o reinício da contagem (Estado seguinte = 0000)

Estado	Q ₃	Q ₂	Q ₁	Q ₀
2	0	0	1	0
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
13	1	1	0	1

J ₃	K ₃	J ₂	K ₂	J ₁	K ₁	J ₀	K ₀
0	X	0	X	X	1	0	X
0	X	X	1	0	X	0	X
0	X	X	1	0	X	X	1
0	X	X	1	X	1	0	X
X	1	0	X	0	X	X	1
X	1	0	X	X	1	0	X
X	1	0	X	X	1	X	1
X	1	X	1	0	X	X	1

Q_1Q_0		J_3				J_2				J_1				J_0						
		Q_3Q_2	00	01	11	10	00	01	11	10	00	01	11	10	00	01	11	10		
00	00	0	0	X	X	00	0	X	X	0	00	0	0	0	0	0	0	0		
01	00	0	0	X	X	01	0	X	X	0	01	1	0	0	0	01	X	X	X	X
11	01	0	1	X	X	11	1	X	X	0	11	X	X	X	X	11	X	X	X	X
10	11	0	0	X	X	10	0	X	X	0	10	X	X	X	X	10	0	0	0	0

Q_1Q_0		K_3				K_2				K_1				K_0						
		Q_3Q_2	00	01	11	10	00	01	11	10	00	01	11	10	00	01	11	10		
00	00	X	X	0	1	00	X	1	1	X	00	X	X	X	X	00	X	X	X	X
01	00	X	X	1	1	01	X	1	1	X	01	X	X	X	X	01	0	1	1	1
11	01	X	X	0	1	11	X	0	0	X	11	0	0	0	1	11	0	0	1	1
10	11	X	X	0	1	10	X	1	0	X	10	1	1	1	1	10	X	X	X	X

$$\begin{aligned}
 J_3 &= \overline{Q_0} Q_1 \overline{Q_2} & J_2 &= \overline{Q_0} \overline{Q_1} \overline{Q_3} & J_1 &= \overline{Q_0} \overline{Q_2} \overline{Q_3} & J_0 &= \overline{Q_1} \overline{Q_2} \overline{Q_3} \\
 K_3 &= \overline{Q_2} + \overline{Q_0} Q_1 & K_2 &= \overline{Q_1} + \overline{Q_0} \overline{Q_3} & K_1 &= \overline{Q_0} + \overline{Q_2} \overline{Q_3} & K_0 &= \overline{Q_3} + \overline{Q_1} \overline{Q_2}
 \end{aligned}$$

Q_1Q_0		J_3				J_2				J_1				J_0			
		Q_3Q_2	00	01	11	10	00	01	11	10	00	01	11	10	00	01	11
00	00	0	X	X	X	0	X	X	0	0	X	0	0	1	X	0	0
01	00	0	X	X	X	0	X	X	X	1	X	X	X	X	X	X	X
11	00	0	1	X	X	1	X	X	X	X	X	X	X	X	X	X	X
10	00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	X

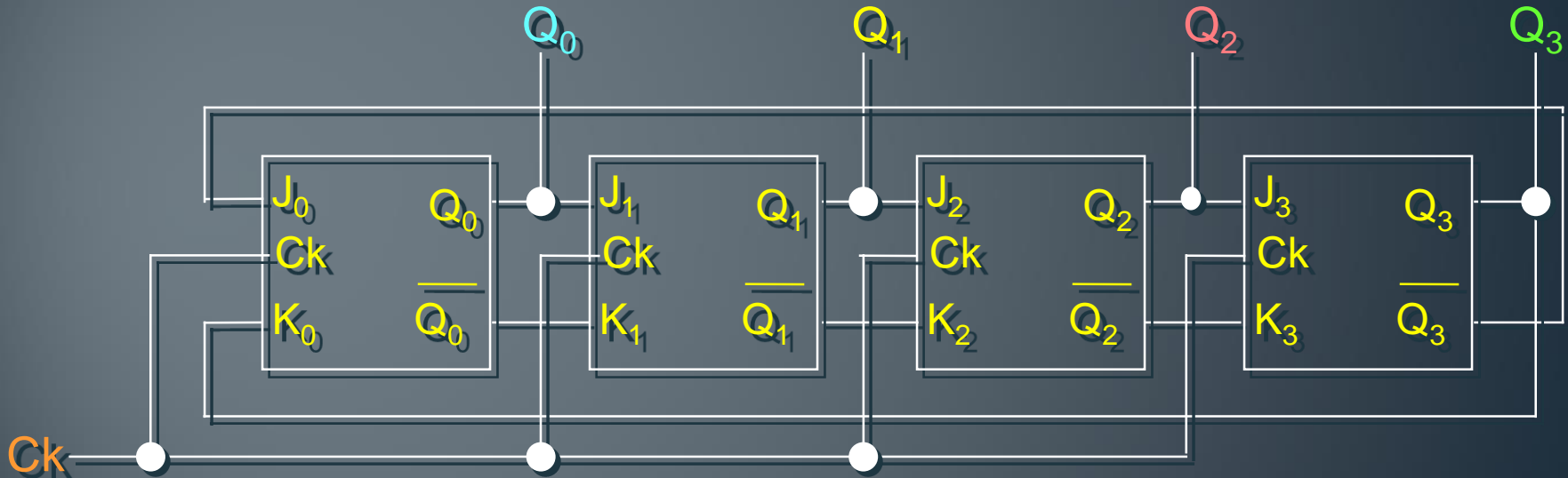
Q_1Q_0		K_3				K_2				K_1				K_0			
		Q_3Q_2	00	01	11	10	00	01	11	10	00	01	11	10	00	01	11
00	00	X	X	0	1	X	X	1	X	X	X	X	X	X	X	X	X
01	00	X	X	X	X	X	X	X	X	X	X	X	X	0	X	X	X
11	00	X	X	0	X	X	0	0	X	0	0	0	X	0	0	1	X
10	00	X	X	0	X	X	X	0	X	X	X	1	X	X	X	X	X

Considerando os estados faltantes como irrelevantes:

$$\begin{array}{cccc}
 J_3 = \underline{Q_2} & J_2 = \underline{Q_1} & J_1 = \underline{Q_0} & J_0 = Q_3 \\
 K_3 = Q_2 & K_2 = Q_1 & K_1 = Q_0 & K_0 = Q_3
 \end{array}$$

Considerando os estados faltantes como irrelevantes:

$$\begin{array}{llll} J_3 = Q_2 & J_2 = Q_1 & J_1 = Q_0 & J_0 = \overline{Q_3} \\ K_3 = \overline{Q_2} & K_2 = \overline{Q_1} & K_1 = \overline{Q_0} & K_0 = Q_3 \end{array}$$



Contador JOHNSON ("Anel Torcido")