

Máquina de Estados Finitos

Implementação com Flip-flops tipos JK e T

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Exemplo: controlador de nível

(experiência 6)

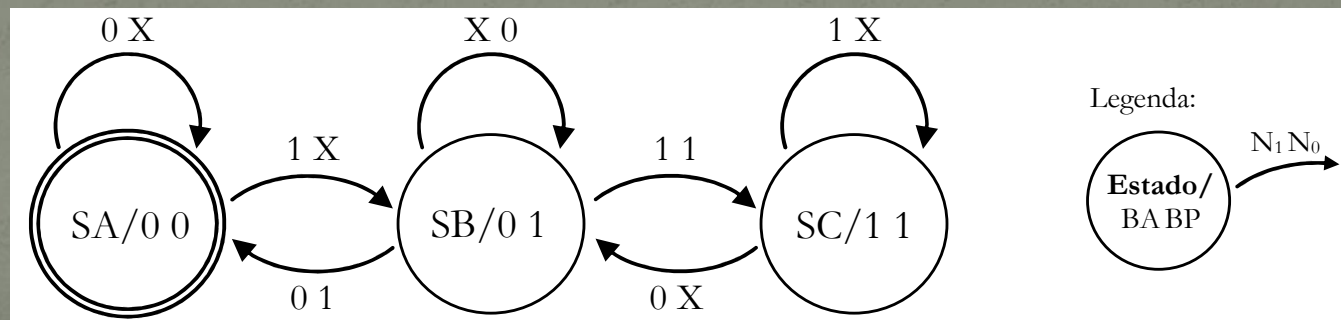
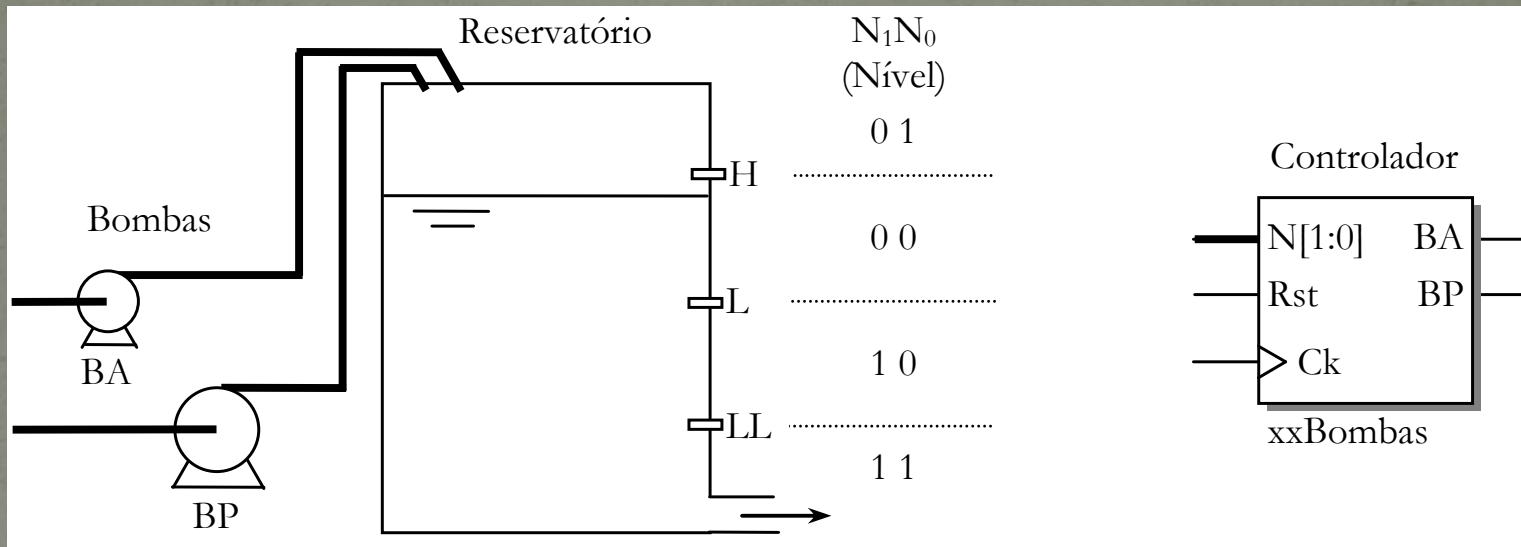
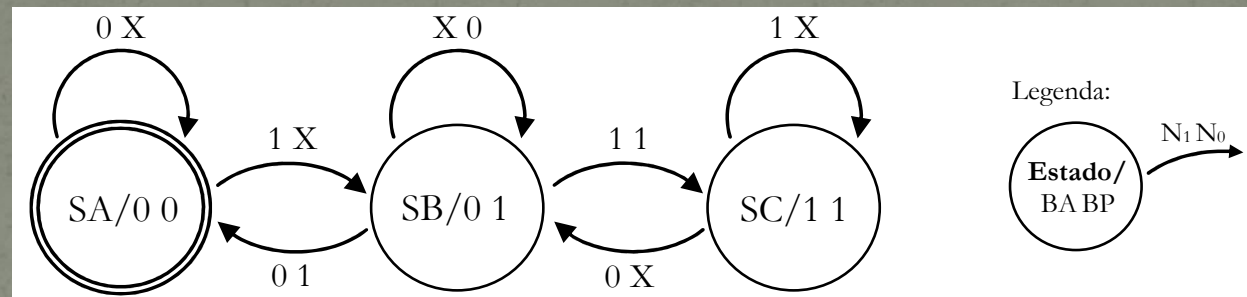
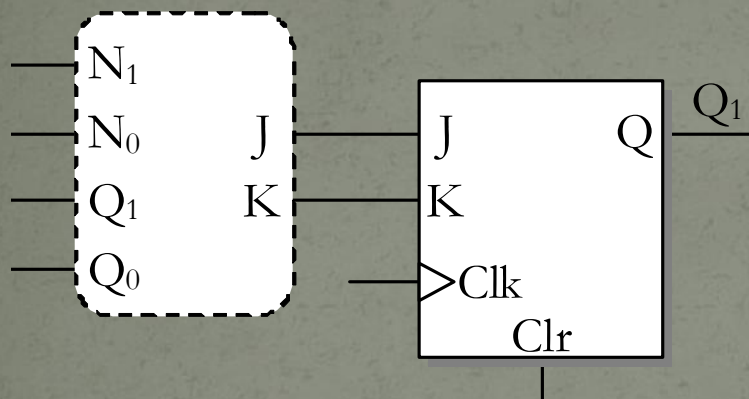


Tabela de Transição



Est.	$(Q_1 Q_0)^k$	$(Q_1 Q_0)^{k+1}$			
		$N_1 N_0$ 0 0	$N_1 N_0$ 0 1	$N_1 N_0$ 1 1	$N_1 N_0$ 1 0
SA	0 0	0 0	0 0	0 1	0 1
SB	0 1	0 1	0 0	1 1	0 1
SC	1 1	0 1	0 1	1 1	1 1
--	1 0	0 0	0 0	0 0	0 0

Implementação de Q_1 com ff. JK



Clr	Clk	J K	Q^{k+1}	
1	X	X X	0	(clear assíncrono)
0	$\uparrow$	0 0	Q^k	(mantém)
0	$\uparrow$	0 1	0	(reset)
0	$\uparrow$	1 0	1	(set)
0	$\uparrow$	1 1	$(Q^k)'$	(troca)

Tabela de Excitação do ff. JK

$Q^k \rightarrow Q^{k+1}$	J K	Obs.
0 $\rightarrow$ 0	0 X	mantém ou reset
0 $\rightarrow$ 1	1 X	troca ou set
1 $\rightarrow$ 0	X 1	troca ou reset
1 $\rightarrow$ 1	X 0	mantém ou set

Transições Q_1 e excitação do ff. JK

Est.	$(Q_1 Q_0)^k$	$(Q_1 Q_0)^{k+1}$			
		$N_1 N_0$ 0 0	$N_1 N_0$ 0 1	$N_1 N_0$ 1 1	$N_1 N_0$ 1 0
SA	0 0	0 0	0 0	0 1	0 1
SB	0 1	0 1	0 0	1 1	0 0
SC	1 1	0 1	0 1	1 1	1 1
--	1 0	0 0	0 0	0 0	0 0

$Q^k \rightarrow Q^{k+1}$	J K	Obs.
0 $\rightarrow$ 0	0 X	mantém ou reset
0 $\rightarrow$ 1	1 X	troca ou set
1 $\rightarrow$ 0	X 1	troca ou reset
1 $\rightarrow$ 1	X 0	mantém ou set

$(Q_1 Q_0)^k$	$Q_1^{k+1} \quad J \quad K$			
	$N_1 N_0$ 0 0	$N_1 N_0$ 0 1	$N_1 N_0$ 1 1	$N_1 N_0$ 1 0
0 0	0 0 X	0 0 X	0 0 X	0 0 X
0 1	0 0 X	0 0 X	1 1 X	0 0 X
1 1	0 X 1	0 X 1	1 X 0	1 X 0
1 0	0 X 1	0 X 1	0 X 1	0 X 1

Equações de J e K

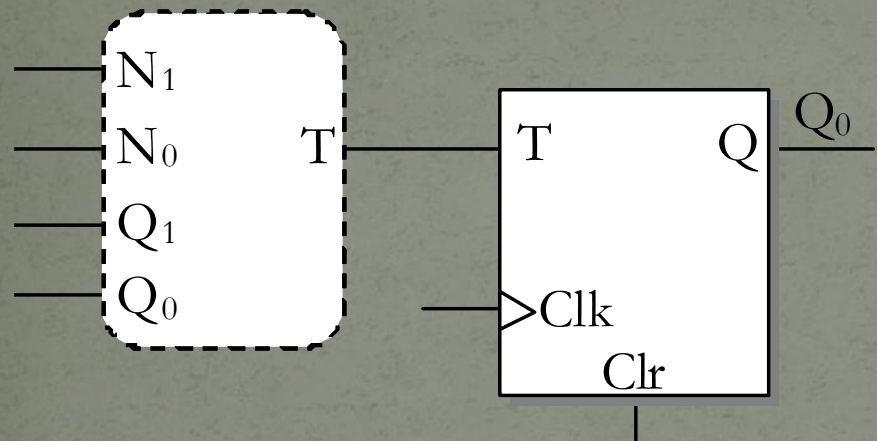
$Q_1Q_0 \backslash N_1N_0$					
		00	01	11	10
00	0	0	0	0	0
01	0	0	1	0	0
11	X	X	X	X	X
10	X	X	X	X	X

$$J = N_1 \cdot N_0 \cdot Q_0$$

$Q_1Q_0 \backslash N_1N_0$					
		00	01	11	10
00	X	X	X	X	X
01	X	X	X	X	X
11	1	1	0	0	0
10	1	1	1	1	1

$$K = N_0' + Q_0'$$

Implementação de Q_0 com ff. T



Clr	Clk	T	Q^{k+1}	
1	X	X	0	(clear assíncrono)
0	$\uparrow$	0	Q^k	(mantém)
0	$\uparrow$	1	$(Q^k)'$	(troca)

Tabela de Excitação do ff. T

$Q^k \rightarrow Q^{k+1}$	T	Obs.
0 $\rightarrow$ 0	0	mantém
0 $\rightarrow$ 1	1	troca
1 $\rightarrow$ 0	1	troca
1 $\rightarrow$ 1	0	mantém

Transições de Q_0 e excitação do ff. T

Est.	$(Q_1 Q_0)^k$	$(Q_1 Q_0)^{k+1}$			
		$N_1 N_0$ 0 0	$N_1 N_0$ 0 1	$N_1 N_0$ 1 1	$N_1 N_0$ 1 0
SA	0 0	0 0	0 0	0 1	0 1
SB	0 1	0 1	0 0	1 1	0 0
SC	1 1	0 1	0 1	1 1	1 1
--	1 0	0 0	0 0	0 0	0 0

$Q^k \rightarrow Q^{k+1}$	T	Obs.
0 $\rightarrow$ 0	0	mantém
0 $\rightarrow$ 1	1	troca
1 $\rightarrow$ 0	1	troca
1 $\rightarrow$ 1	0	mantém

$(Q_1 Q_0)^k$	$Q_0^{k+1} \quad T$			
	$N_1 N_0$ 0 0	$N_1 N_0$ 0 1	$N_1 N_0$ 1 1	$N_1 N_0$ 1 0
0 0	0 0	0 0	1 1	1 1
0 1	1 0	0 1	1 0	0 1
1 1	1 0	1 0	1 0	1 0
1 0	0 0	0 0	0 0	0 0

Equação de T

		N_1N_0			
		00	01	11	10
Q_1Q_0	00	0	0	1	1
	01	0	1	0	1
	11	0	0	0	0
	10	0	0	0	0

$$T = N_1.Q_1'.Q_0' + N_1.N_0'.Q_1' + N_1'.N_0.Q_1'.Q_0$$