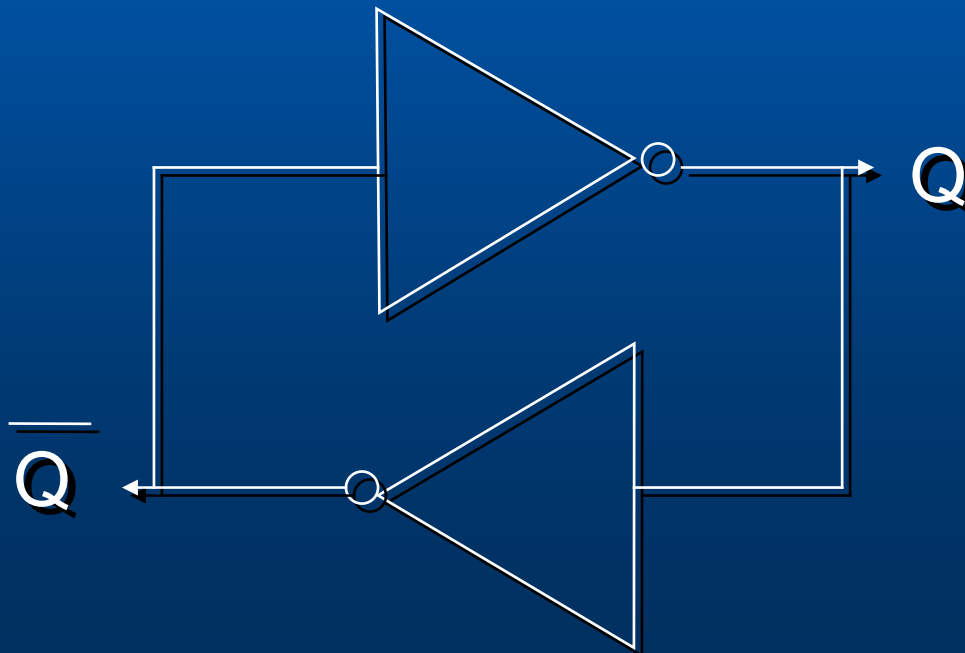


CIRCUITOS BIESTÁVEIS

Sel 414 - Sistemas Digitais

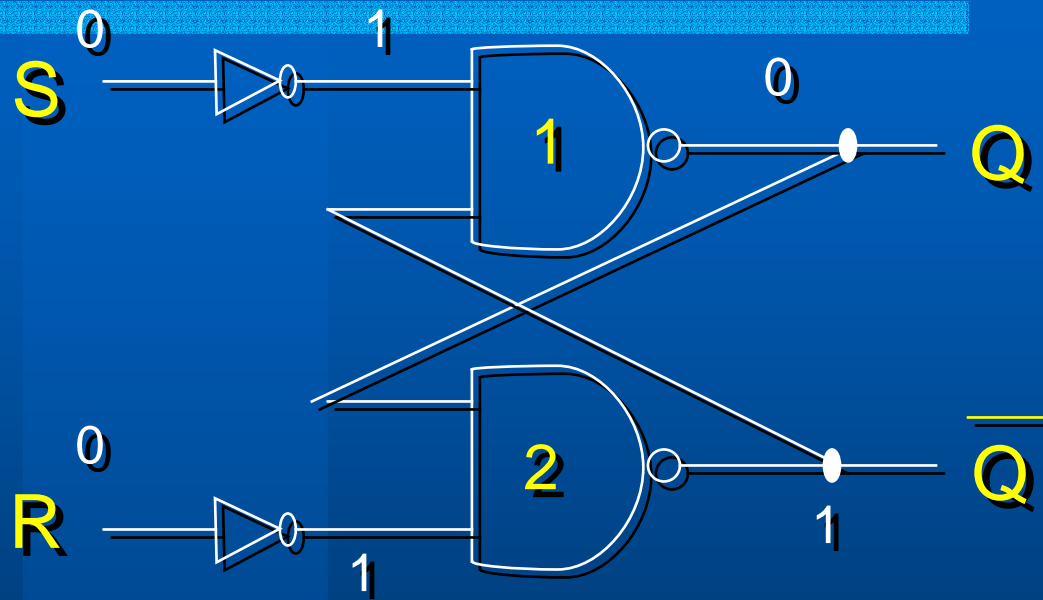
Prof. Homero Schiabel

LATCH RS



Latch RS

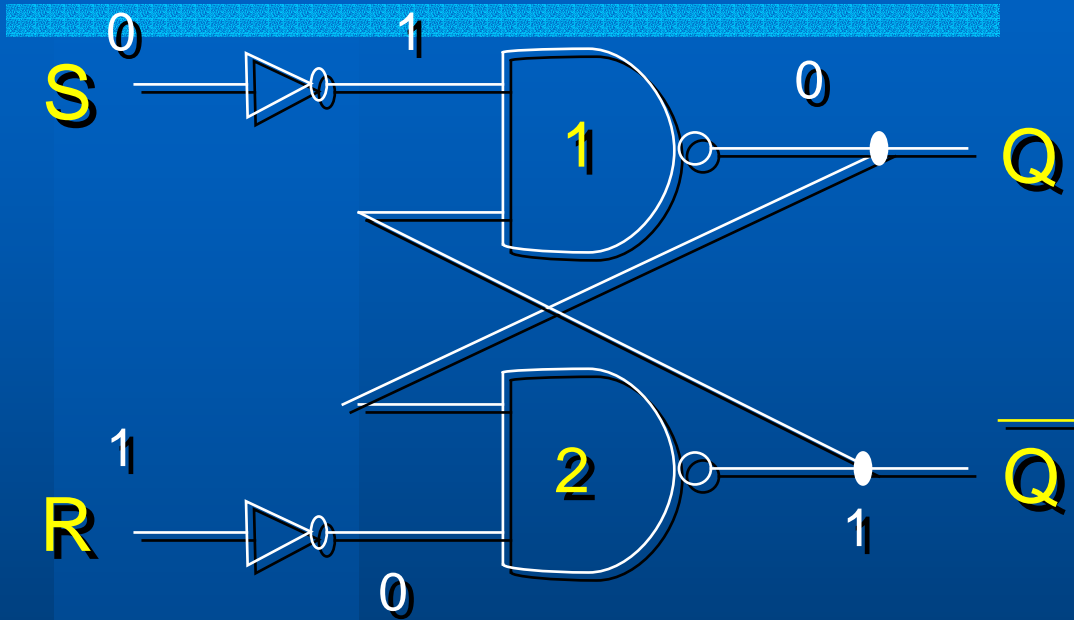
Condição Inicial → Q = 0



S	R	1	2	Q	\overline{Q}
0	0	1	0	0	1

Latch RS

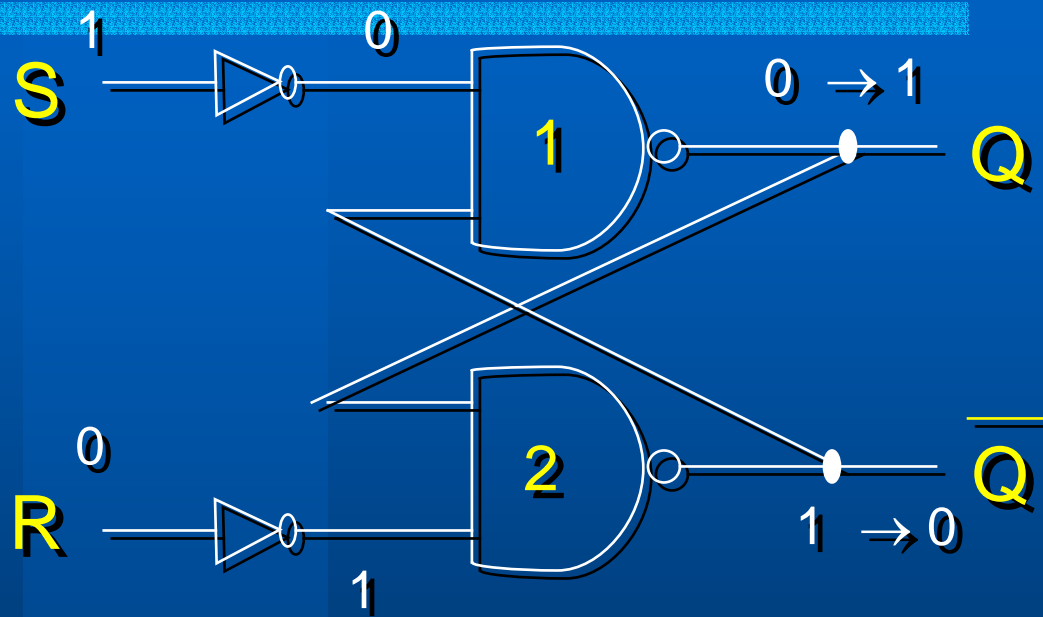
Condição Inicial → Q = 0



S	R	1	2	Q	\overline{Q}
0	0	1	1	0	1
0	1	1	1	0	1

Latch RS

Condição Inicial → Q = 0

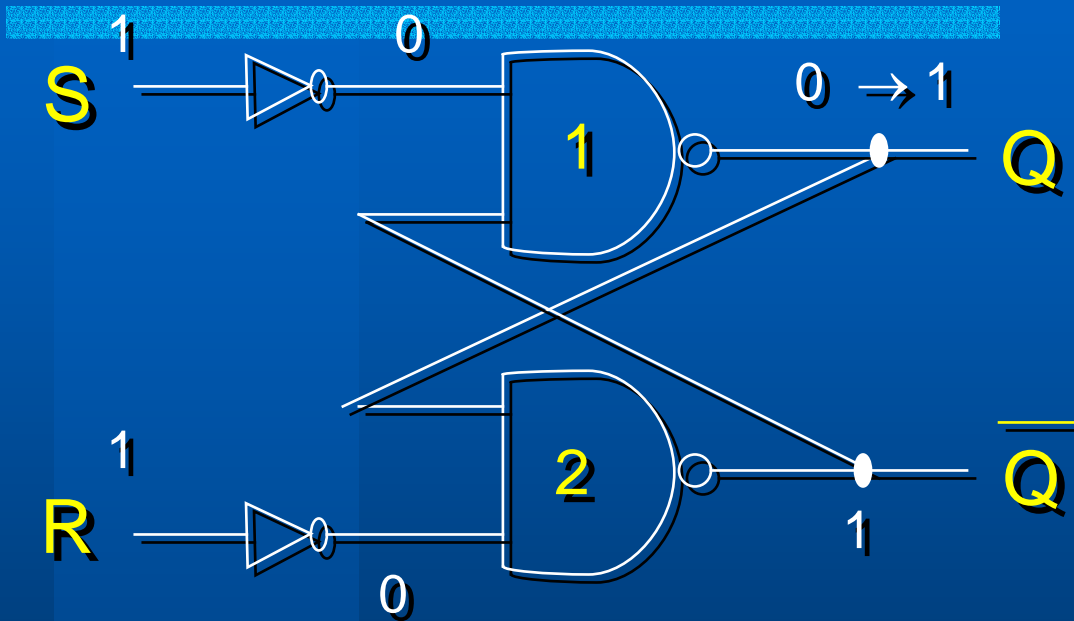


S	R	1	2	Q	\overline{Q}
0	0	1 1	0 1	0	1
0	1	1 1	0 0	0	1
1	0	0 1	0 1	1	1 *
		0 1	1 1	1	0

* Estado instável

Latch RS

Condição Inicial → Q = 0



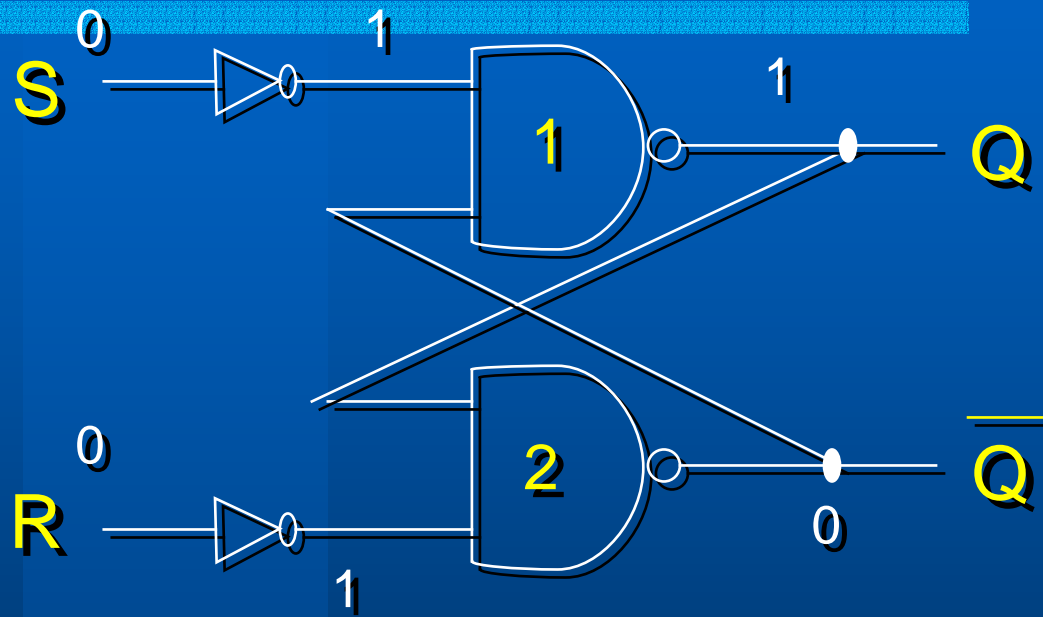
S	R	1	2	Q	\overline{Q}
0	0	1 1	0 1	0	1
0	1	1 1	0 0	0	1
1	0	0 1	0 1	1	1 *
		0 1	1 1	1	0
1	1	0 1	0 0	1	1
		0 1	1 0	1	1 **

* Estado instável

** “Incompatibilidade”
(Est. “proibido”)

Latch RS

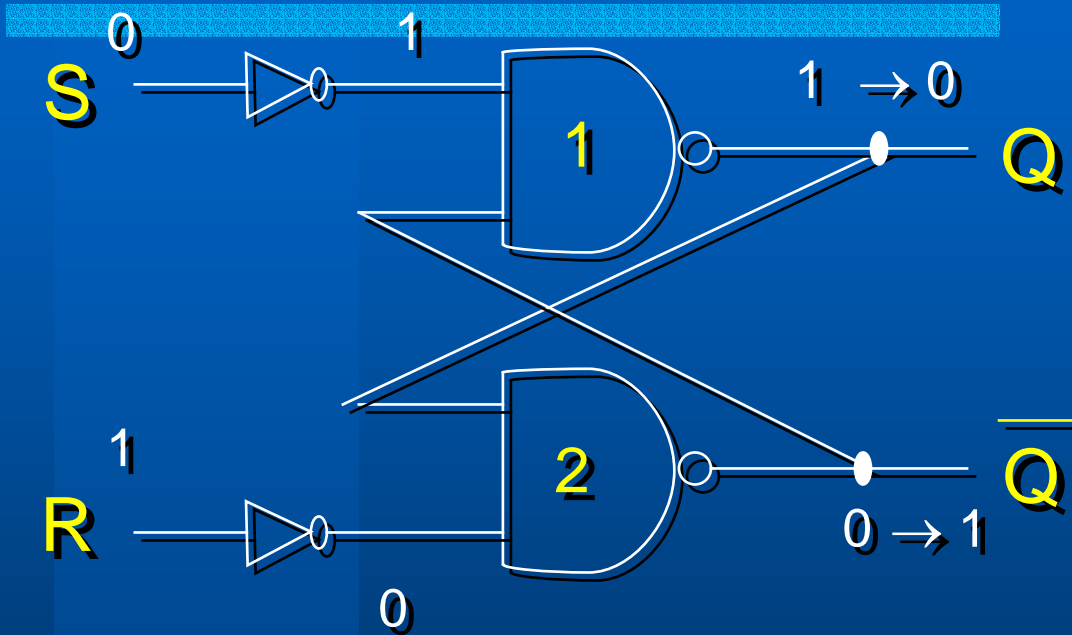
Condição Inicial → Q = 1



S	R	1	2	Q	\overline{Q}
0	0	1	0	1	0

Latch RS

Condição Inicial → Q = 1

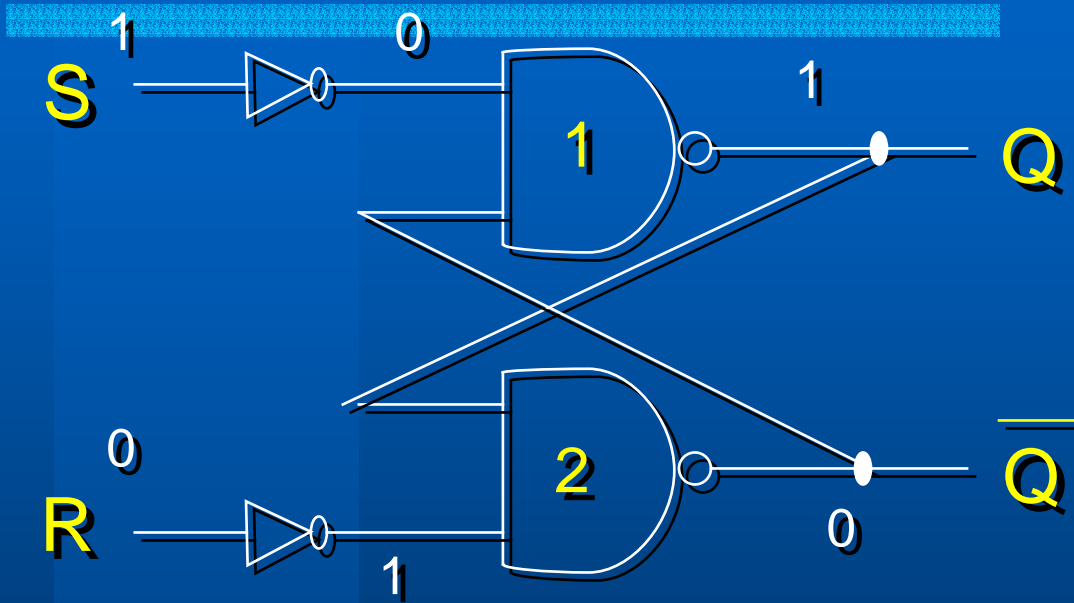


S	R	1	2	Q	\overline{Q}
0	0	1	0	1	0
0	1	1	0	1	1*
		1	1	0	1

* Estado instável

Latch RS

Condição Inicial → Q = 1

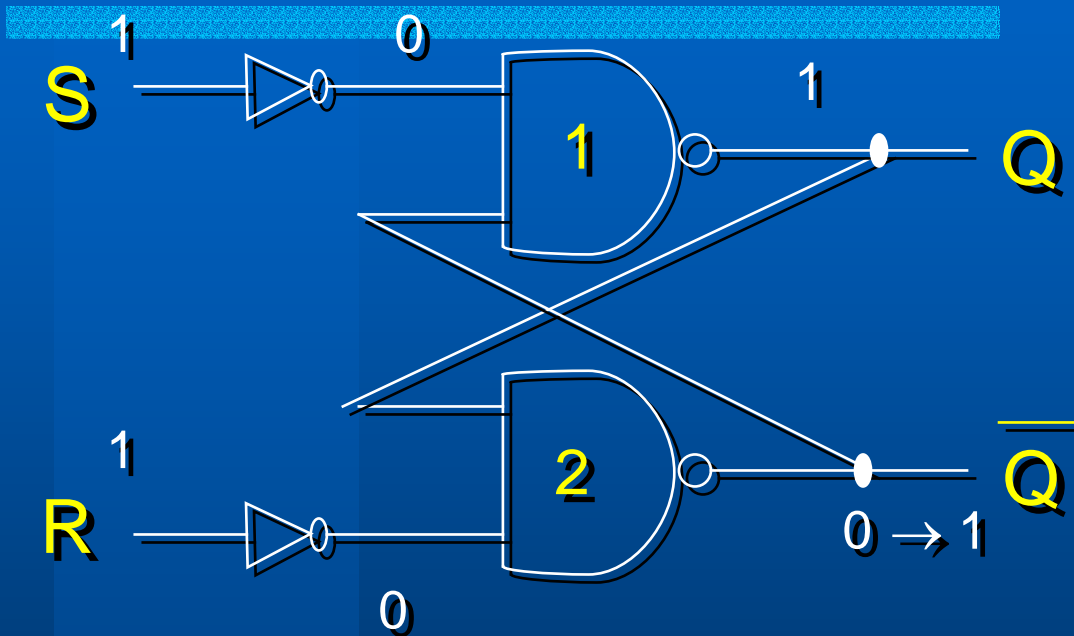


S	R	1	2	Q	\overline{Q}
0	0	10	11	1	0
0	1	10	10	1	1*
		11	10	0	1
1	0	00	11	1	0

* Estado instável

Latch RS

Condição Inicial → Q = 1



S	R	1	2	Q	\overline{Q}
0	0	1 0	1 1	1	0
0	1	1 0	1 0	1	1 *
		1 1	1 0	0	1
1	0	0 0	1 1	1	0
1	1	0 0	1 0	1	1
		0 1	1 0	1	1 **

* Estado instável

** "Incompatibilidade"
(Est. "proibido")

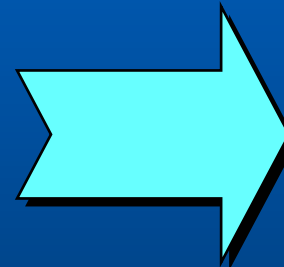
Tabela da verdade:

$Q = 0$

$Q = 1$

S	R	Q	\overline{Q}
0	0	0	1
0	1	0	1
1	0	1	0
1	1	1	1 ^{**}

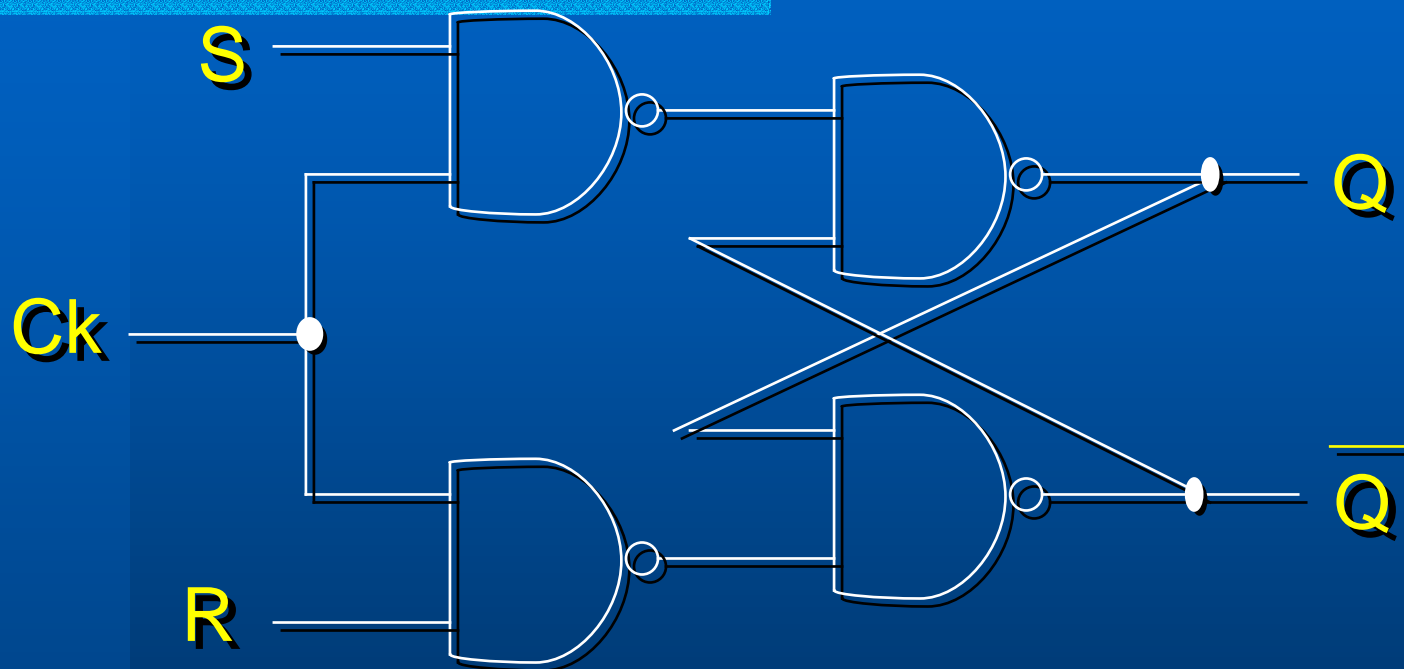
S	R	Q	\overline{Q}
0	0	1	0
0	1	0	1
1	0	1	0
1	1	1	1 ^{**}



S	R	Q*
0	0	Q
0	1	0
1	0	1
1	1	1 ^{**}

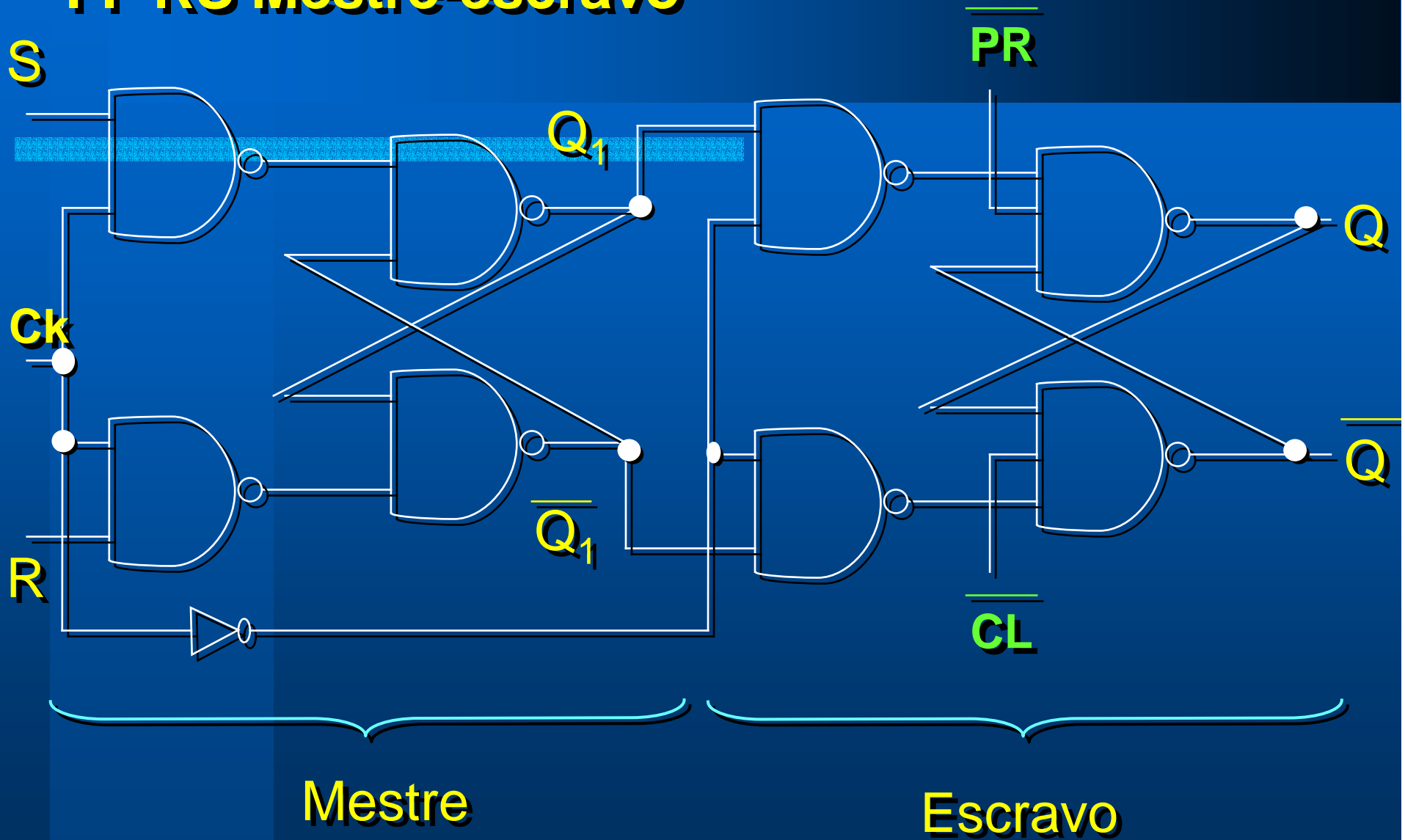
** "Incompatibilidade"
(Est. "proibido")

RS Síncrono



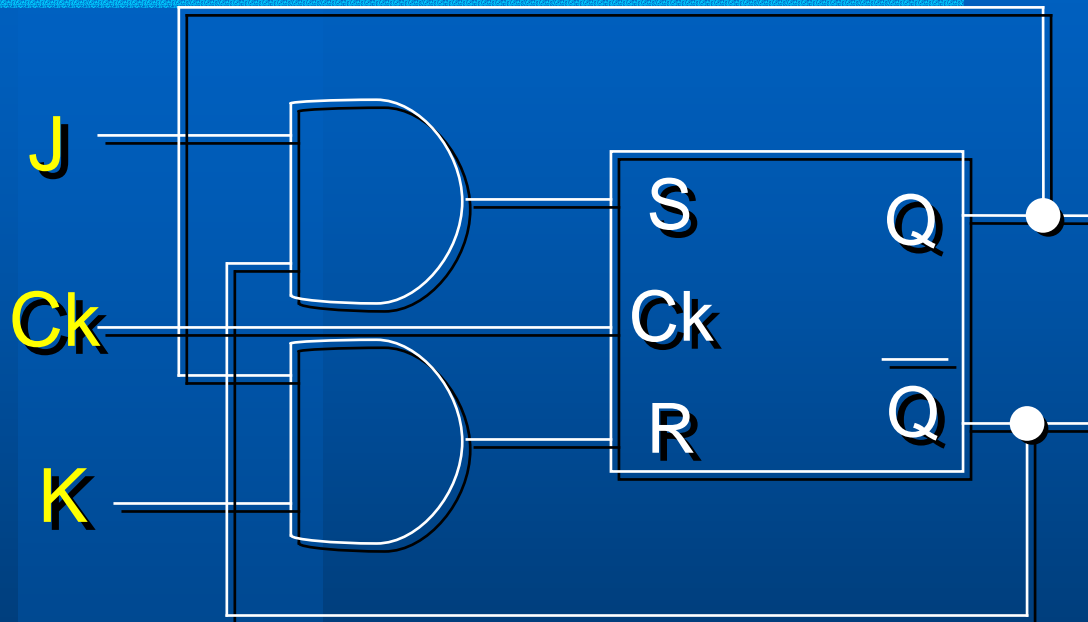
- Para $Ck=0$ → Q e \overline{Q} não “sentirão” eventuais variações nas entradas
- Para $Ck=1$ → funcionamento normal (portas de entrada habilitadas)

FF RS Mestre-escravo



FLIP-FLOP JK

Flip-flop JK

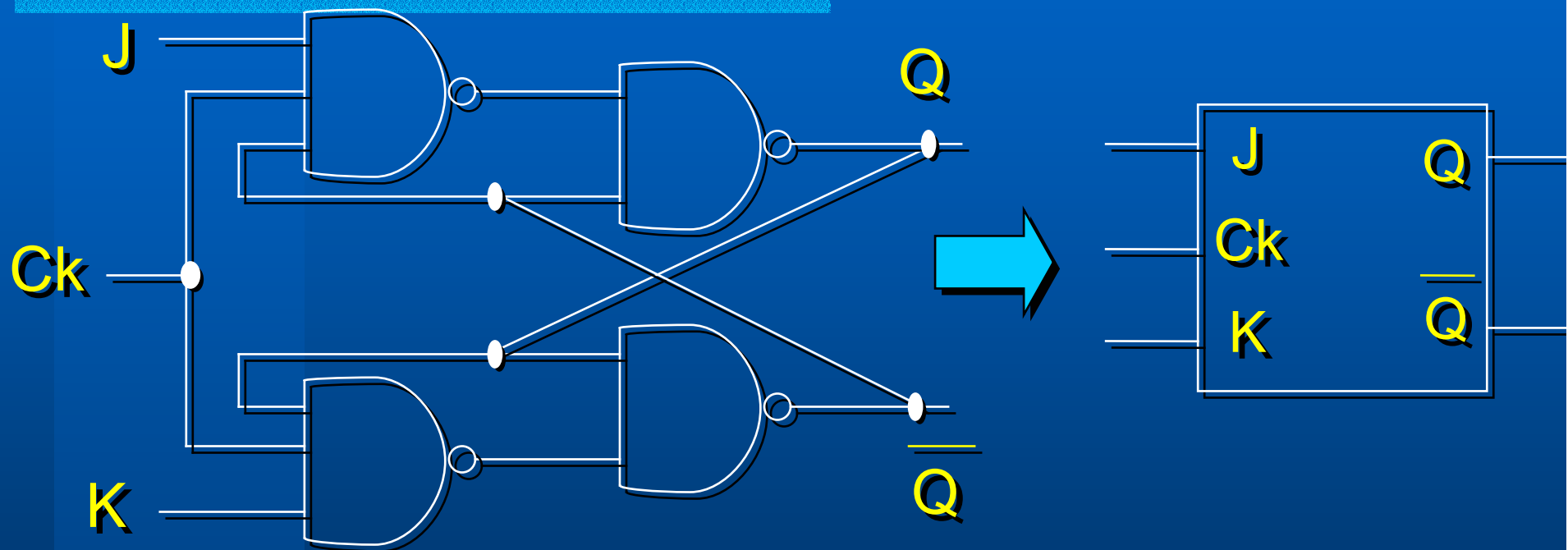


J	K	Q *
0	0	Q
0	1	0
1	0	1
1	1	\overline{Q}

* Após o pulso do Ck

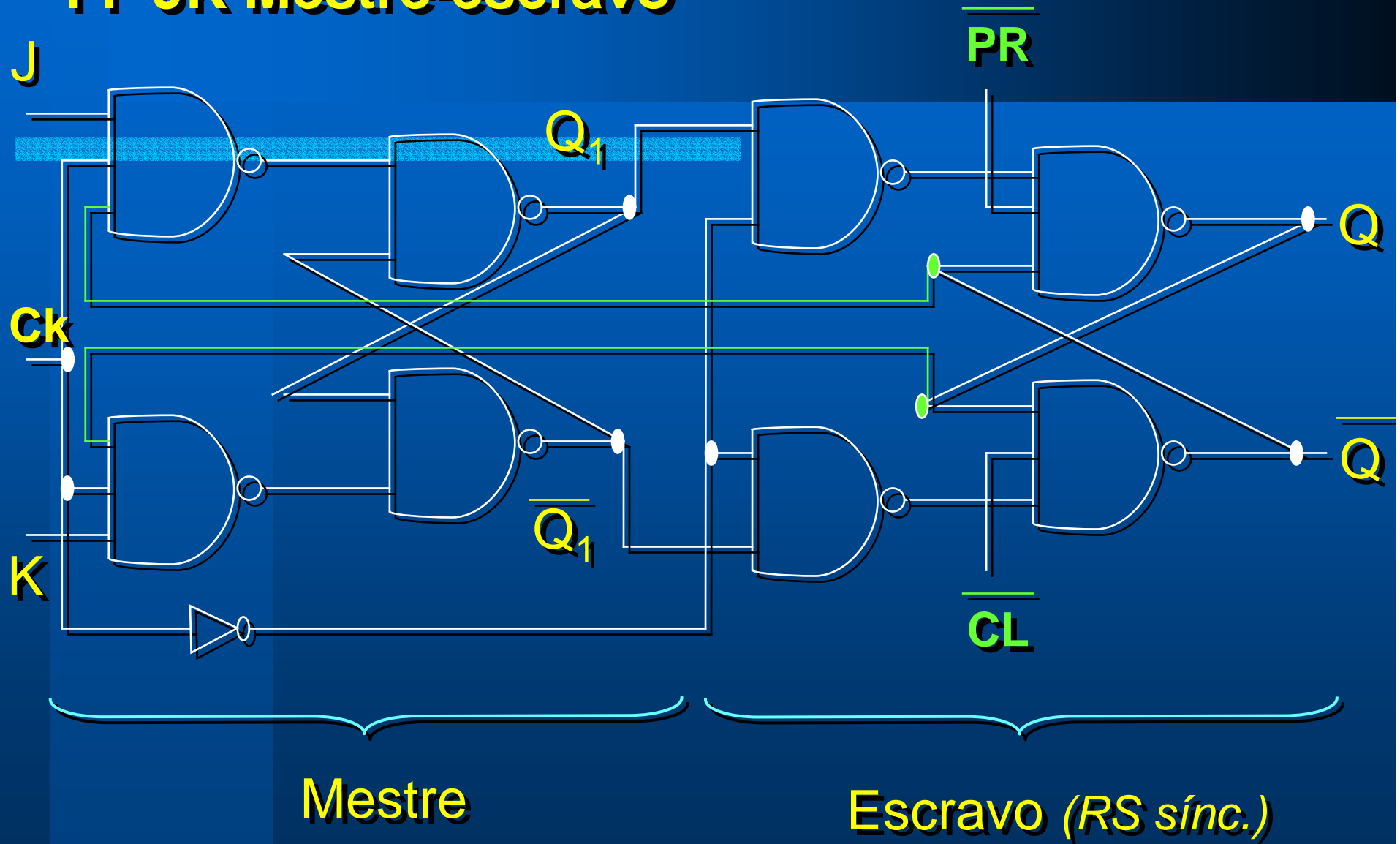
Resolve o problema da indeterminação quando as duas entradas são iguais a 1

Circuito básico real

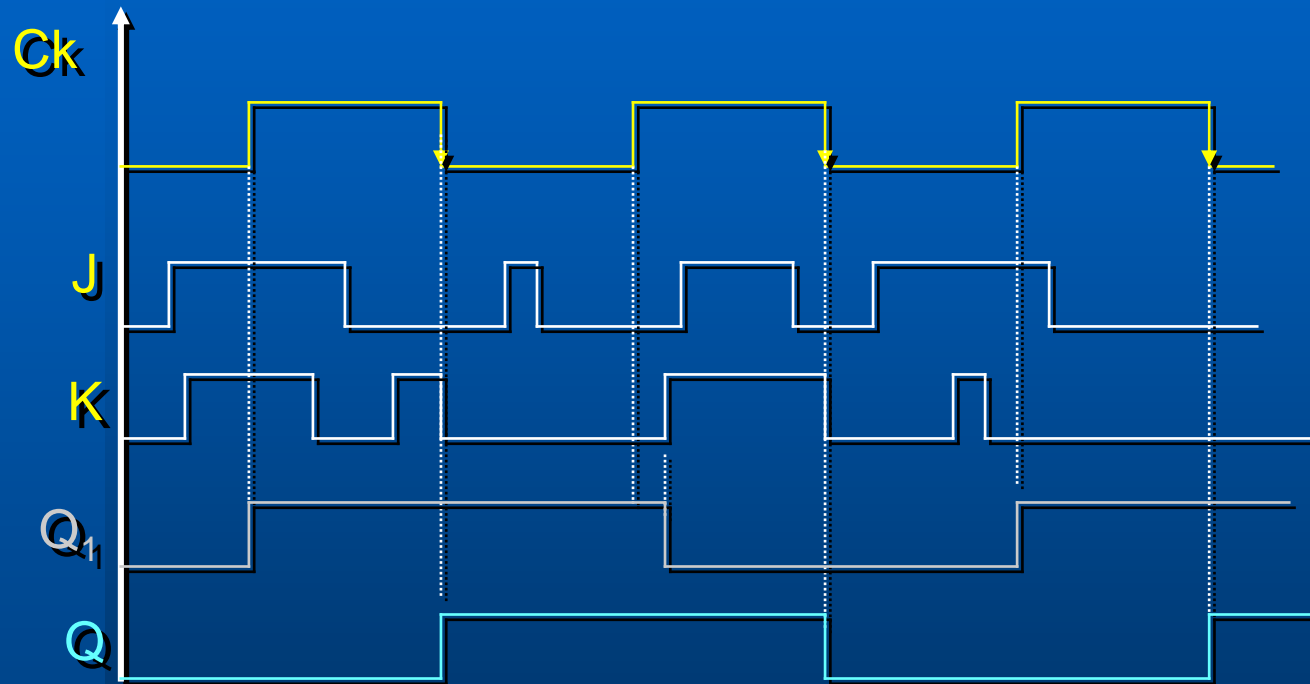


Problema do JK comum: quando o $Ck=1$, há passagem das entradas e realimentações; se, nesse instante, houver mudança de J e/ou K, haverá nova saída → comutação para outro estado mais de uma vez durante o mesmo pulso de Ck

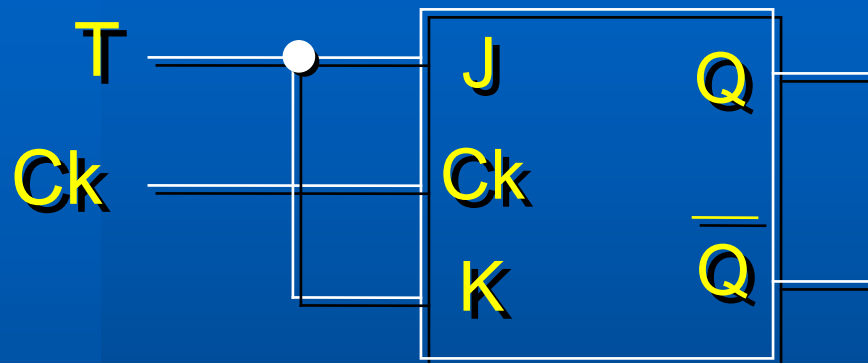
FF JK Mestre-escravo



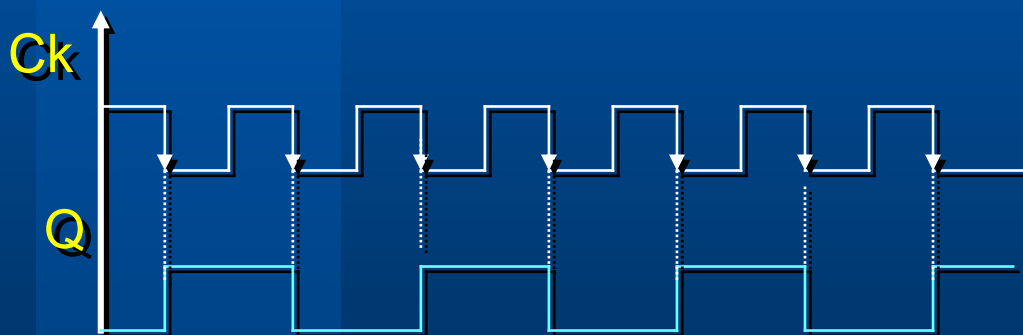
FF JK Mestre-escravo: comportamento



FF Tipo T



T	Q
0	Q
1	\overline{Q}



T = 1

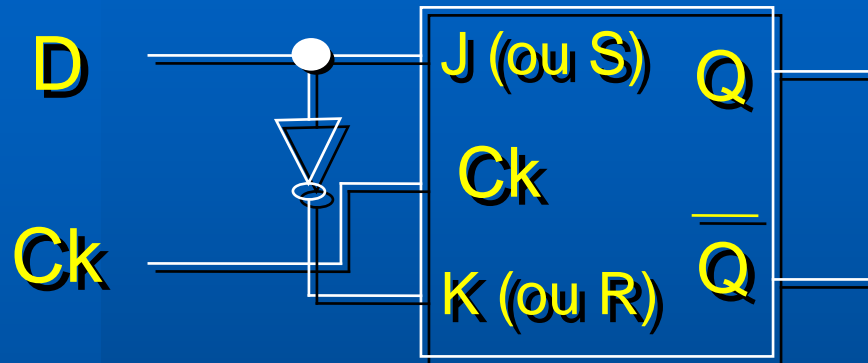


$$f_Q = f_{Ck} / 2$$



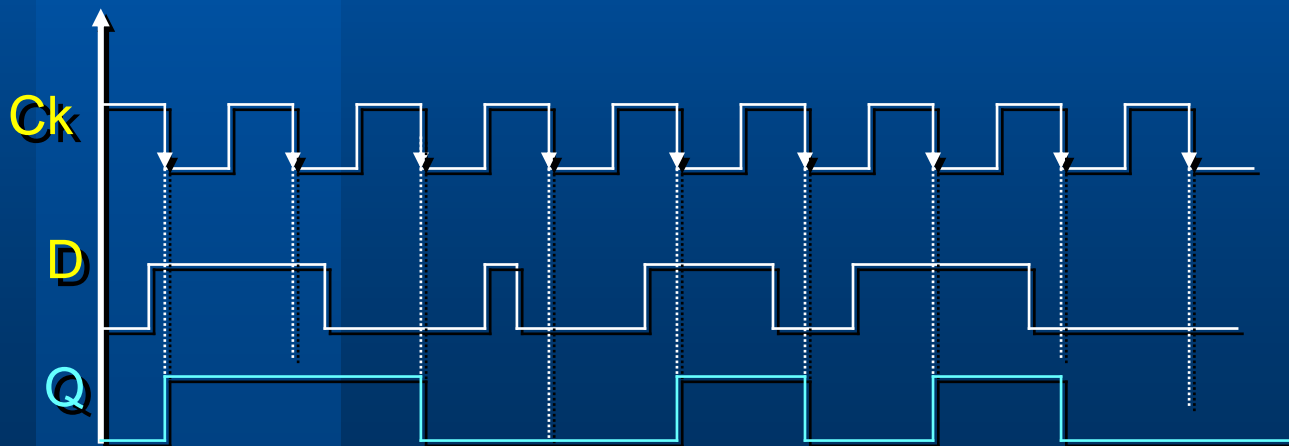
Divisor por 2

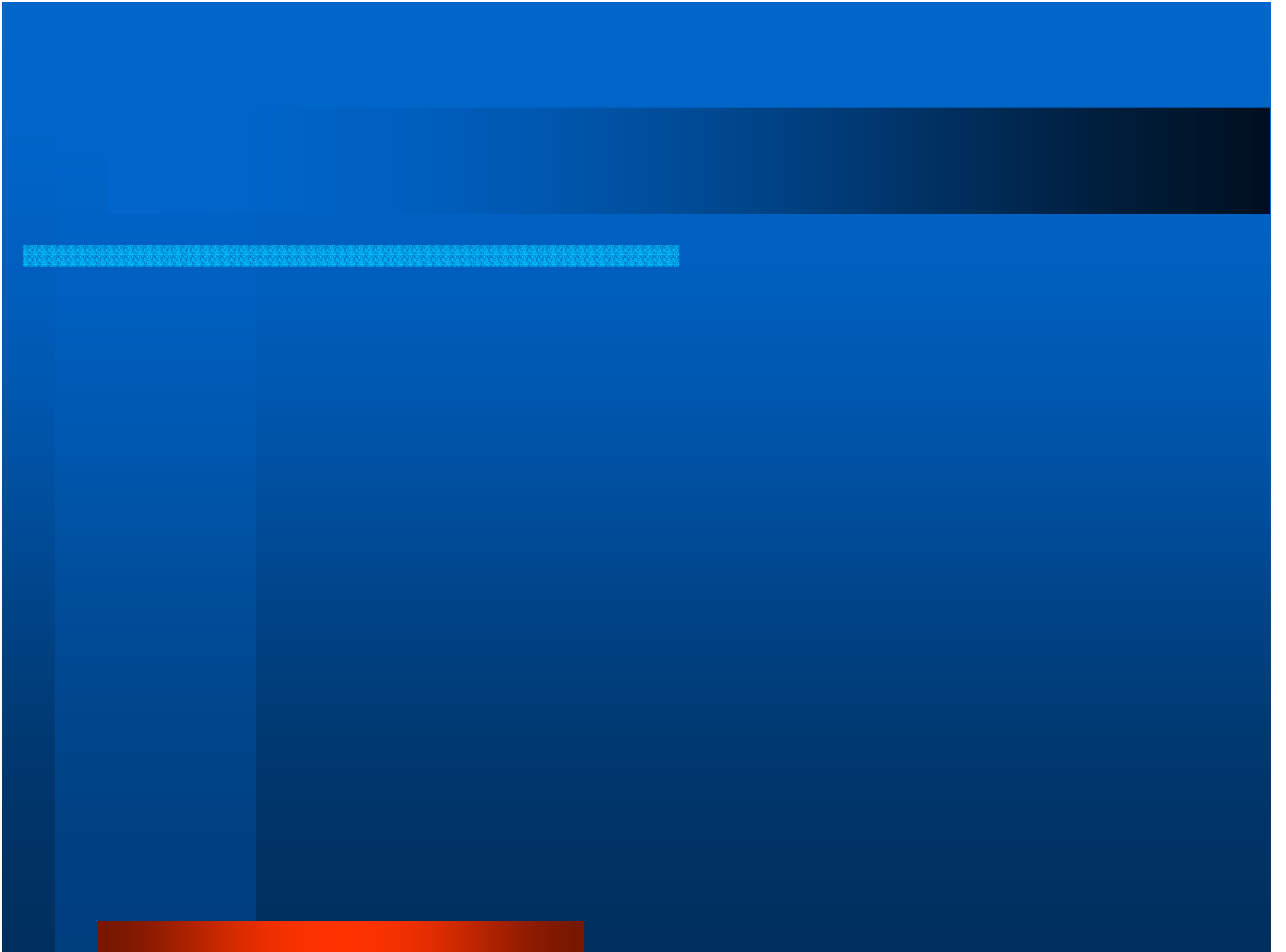
FF Tipo D

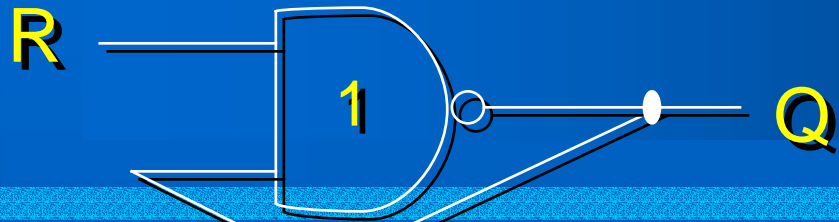


D	Q
0	0
1	1

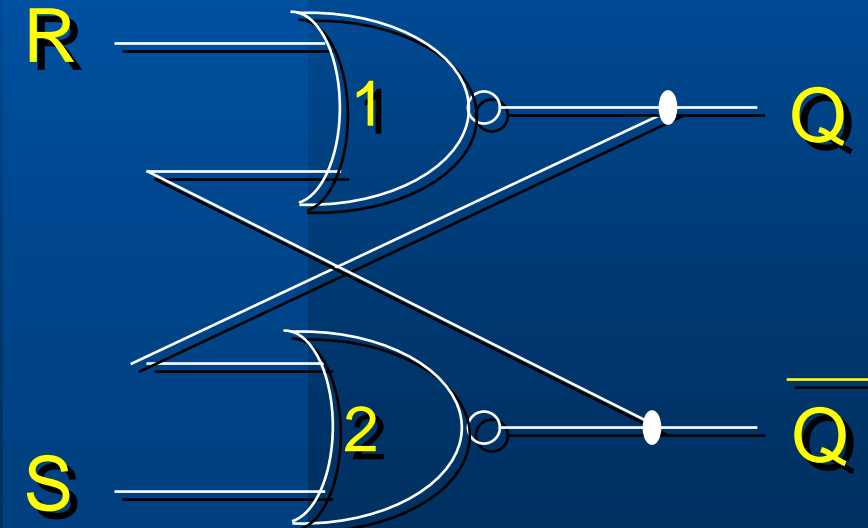
Ck = \uparrow , \downarrow ou nível







R	S	Q
0	0	1 **
0	1	1
1	0	0
1	1	Q_a



R	S	Q
0	0	Q_a
0	1	1
1	0	0
1	1	1 **