

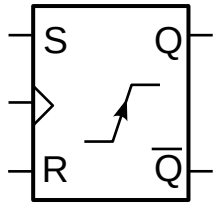
# Ejercicio: Biestable T con carga de datos

## *Circuitos secuenciales*

Electrónica digital

Felipe Machado

# Biestables activos por flanco (*flip-flop*)



T transición estados

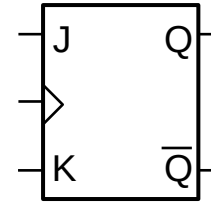
S	R	$Q_t$	$Q_{t+1}$
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	-
1	1	1	-

Tabla de excitación

$Q_t$	$Q_{t+1}$	S	R
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0

T. funcionamiento

S	R	$Q_{t+1}$
0	0	$Q_t$
0	1	0
1	0	1
1	1	-



T transición estados

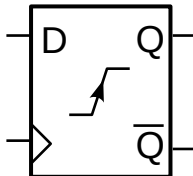
J	K	$Q_t$	$Q_{t+1}$
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

Tabla de excitación

$Q_t$	$Q_{t+1}$	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

T. funcionamiento

J	K	$Q_{t+1}$
0	0	$Q_t$
0	1	0
1	0	1
1	1	$\overline{Q_t}$



T transición estados

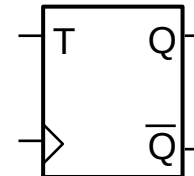
D	$Q_t$	$Q_{t+1}$
0	0	0
0	1	0
1	0	1
1	1	1

Tabla de excitación

$Q_t$	$Q_{t+1}$	D
0	0	0
0	1	1
1	0	0
1	1	1

T. funcionamiento

D	$Q_{t+1}$
0	0
1	1



T transición estados

T	$Q_t$	$Q_{t+1}$
0	0	0
0	1	1
1	0	1
1	1	0

Tabla de excitación

$Q_t$	$Q_{t+1}$	T
0	0	0
0	1	1
1	0	1
1	1	0

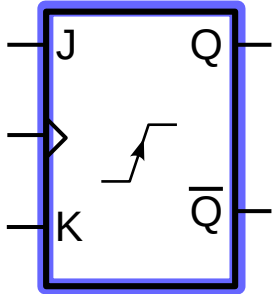
T. funcionamiento

T	$Q_{t+1}$
0	$Q_t$
1	$\overline{Q_t}$

# Conversión de biestables

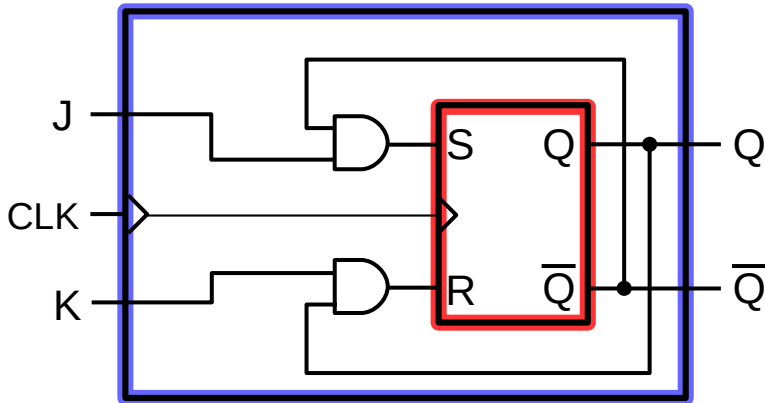
## Biestable J-K a partir de S-R

Lo que quiero



J	K	$Q_t$	$Q_{t+1}$	S	R
0	0	0	0	0	X
0	0	1	1	X	0
0	1	0	0	0	X
0	1	1	0	0	1
1	0	0	1	1	0
1	0	1	1	X	0
1	1	0	1	1	0
1	1	1	0	0	1

Entradas                      Salidas



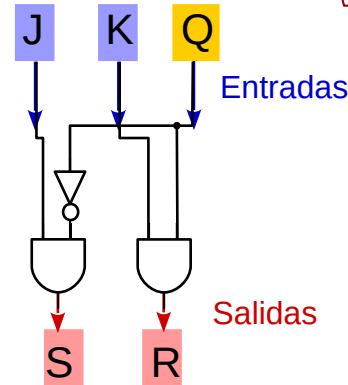
S	$Q_t$	
0	1	
00	0	X
01	0	0
11	1	0
10	1	X

J-K

R	$Q_t$	
0	1	
00	X	0
01	X	1
11	0	1
10	0	0

J-K

$K \cdot Q_t$

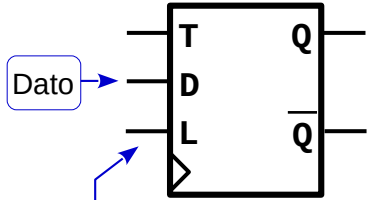


$$S = J \cdot \overline{Q}_t$$

$$R = K \cdot Q_t$$

# Biestable T con carga de datos

Lo que quiero



Carga (*load*) síncrona

T. funcionamiento

	L	D	T	$Q_{t+1}$
T	0	X	0	$Q_t$
	0	X	1	$\overline{Q_t}$
D	1	0	X	0
	1	1	X	1

Tabla de transición de estados

L	D	T	$Q_t$	$Q_{t+1}$
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

T

D

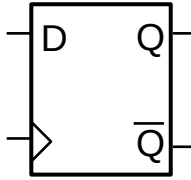
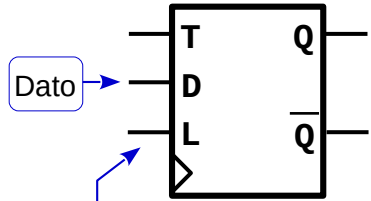


Tabla de excitación

$Q_t$	$Q_{t+1}$	D
0	0	0
0	1	1
1	0	0
1	1	1

# Biastable T con carga de datos

Lo que quiero

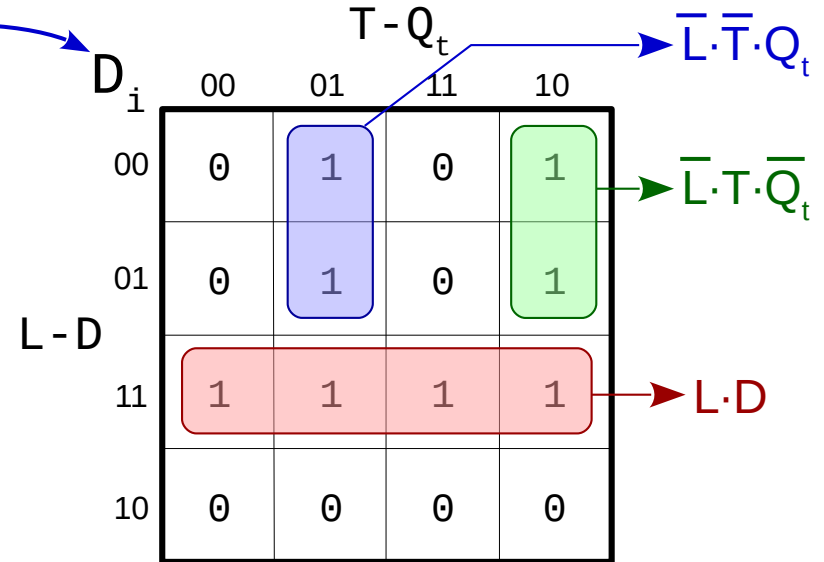
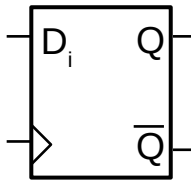


Carga (load) síncrona

T. funcionamiento

	L	D	T	$Q_{t+1}$
T	0	X	0	$Q_t$
	0	X	1	$\overline{Q_t}$
D	1	0	X	0
	1	1	X	1

L	D	T	$Q_t$	$Q_{t+1}$	$D_i$
0	0	0	0	0	0
0	0	0	1	1	1
0	0	1	0	1	1
0	0	1	1	0	0
0	1	0	0	0	0
0	1	0	1	1	1
0	1	1	0	1	1
0	1	1	1	0	0
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	0
1	0	1	1	0	0
1	1	0	0	1	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	1	1



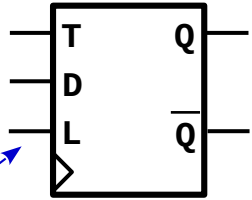
$$D_i = L \cdot D + \overline{L} \cdot T \cdot \overline{Q}_t + \overline{L} \cdot \overline{T} \cdot Q_t$$

$$D_i = L \cdot D + \overline{L} \cdot (T \cdot \overline{Q}_t + \overline{T} \cdot Q_t)$$

$$D_i = L \cdot D + \overline{L} \cdot (T \oplus Q_t)$$

# Biastable T con carga de datos

Lo que quiero



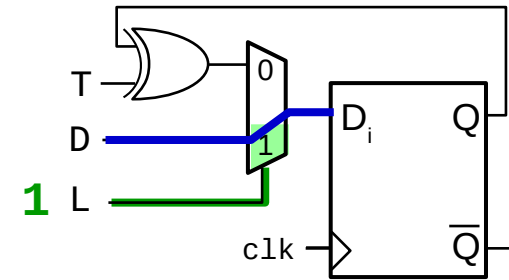
Carga (load) síncrona

T. funcionamiento

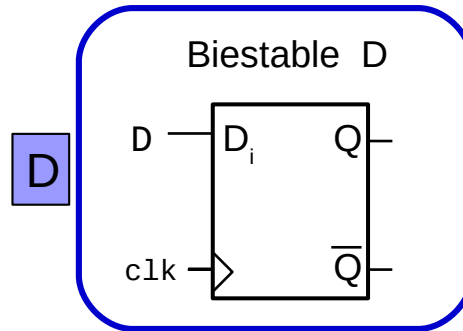
L	D	T	$Q_{t+1}$
0	X	0	$Q_t$
0	X	1	$\overline{Q_t}$
1	0	X	0
1	1	X	1

L	D	T	$Q_t$	$Q_{t+1}$	$D_i$
0	0	0	0	0	0
0	0	0	1	1	1
0	0	1	0	1	1
0	0	1	1	0	0
0	1	0	0	0	0
0	1	0	1	1	1
0	1	1	0	1	1
0	1	1	1	0	0
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	0
1	0	1	1	0	0
1	1	0	0	1	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	1	1

$$D_i = L \cdot D + \overline{L} \cdot (T \oplus Q_t)$$

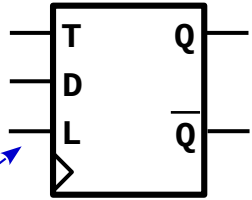


Si L=1



# Biastable T con carga de datos

Lo que quiero



Carga (load) síncrona

T. funcionamiento

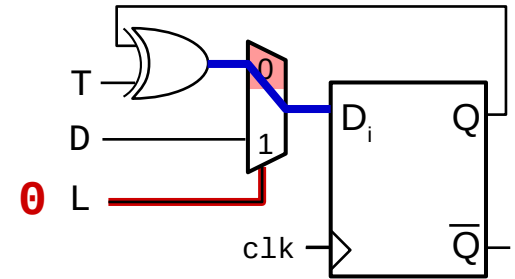
T

L	D	T	$Q_{t+1}$
0	X	0	$Q_t$
0	X	1	$\overline{Q_t}$
1	0	X	0
1	1	X	1

L	D	T	$Q_t$	$Q_{t+1}$	$D_i$
0	0	0	0	0	0
0	0	0	1	1	1
0	0	1	0	1	1
0	0	1	1	0	0
0	1	0	0	0	0
0	1	0	1	1	1
0	1	1	0	1	1
0	1	1	1	0	0
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	0
1	0	1	1	0	0
1	1	0	0	1	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	1	1

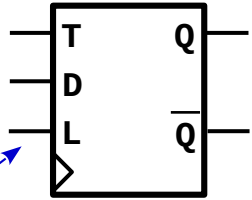
T

$$D_i = L \cdot D + \overline{L} \cdot (T \oplus Q_t)$$



# Biestable T con carga de datos

Lo que quiero



Carga (load) síncrona

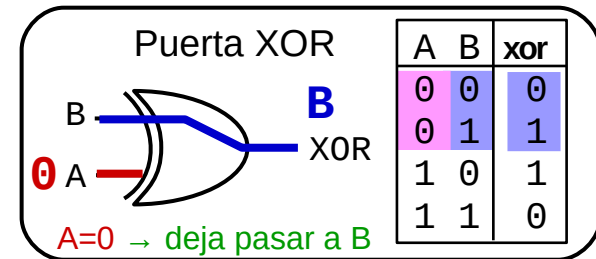
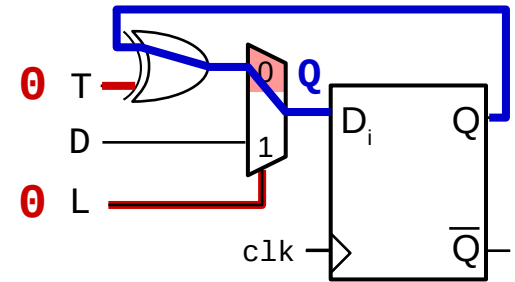
T. funcionamiento

L	D	T	$Q_{t+1}$
0	X	0	$Q_t$
0	X	1	$\overline{Q_t}$
1	0	X	0
1	1	X	1

L	D	T	$Q_t$	$Q_{t+1}$	$D_i$
0	0	0	0	0	0
0	0	0	1	1	1
0	0	1	0	1	1
0	0	1	1	0	0
0	1	0	0	0	0
0	1	0	1	1	1
0	1	1	0	1	1
0	1	1	1	0	0
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	0
1	0	1	1	0	0
1	1	0	0	1	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	1	1

T

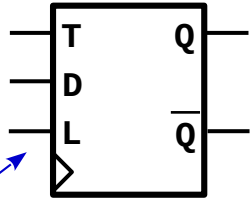
$$D_i = L \cdot D + \overline{L} \cdot (T \oplus Q_t)$$





# Biestable T con carga de datos

Lo que quiero



Carga (load) síncrona

T. funcionamiento

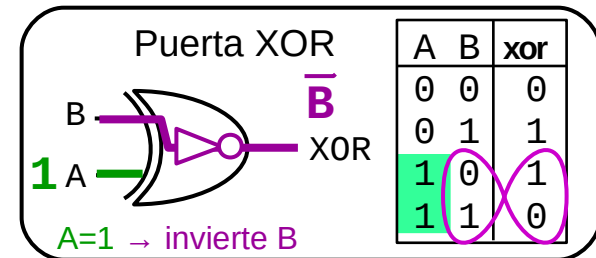
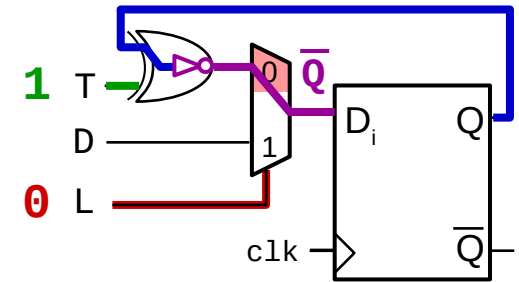
T

L	D	T	$Q_{t+1}$
0	X	0	$Q_t$
0	X	1	$\overline{Q_t}$
1	0	X	0
1	1	X	1

L	D	T	$Q_t$	$Q_{t+1}$	$D_i$
0	0	0	0	0	0
0	0	0	1	1	1
0	0	1	0	1	1
0	0	1	1	0	0
0	1	0	0	0	0
0	1	0	1	1	1
0	1	1	0	1	1
0	1	1	1	0	0
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	0
1	0	1	1	0	0
1	1	0	0	1	1
1	1	0	1	1	1
1	1	1	0	1	1
1	1	1	1	1	1

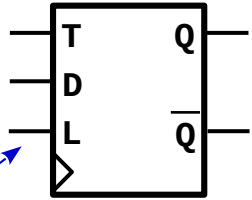
T

$$D_i = L \cdot D + \overline{L} \cdot (T \oplus Q_t)$$



# Biastable T con carga de datos

Lo que quiero



Carga (load) síncrona

T. funcionamiento

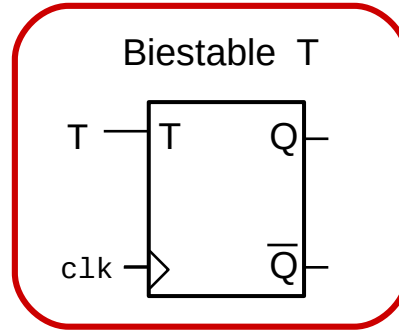
	L	D	T	$Q_{t+1}$
T	0	X	0	$Q_t$
	0	X	1	$\overline{Q_t}$
	1	0	X	0
	1	1	X	1

Tabla de transición de estados

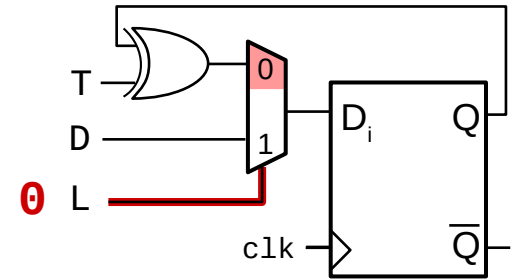
L	D	T	$Q_t$	$Q_{t+1}$
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

T

Si  $L=0$

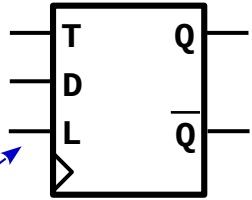


$$D_i = L \cdot D + \overline{L} \cdot (T \oplus Q_t)$$



# Biastable T con carga de datos

Lo que quiero



Carga (load) síncrona

T. funcionamiento

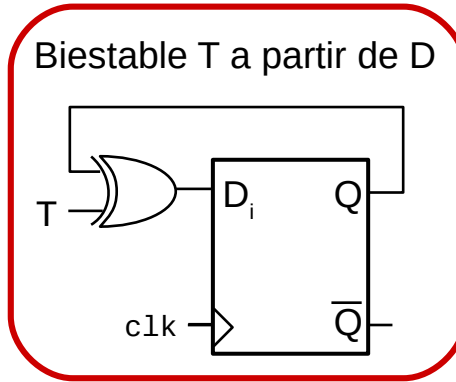
	L	D	T	$Q_{t+1}$
T	0	X	0	$Q_t$
	0	X	1	$\overline{Q_t}$
	1	0	X	0
	1	1	X	1

Tabla de transición de estados

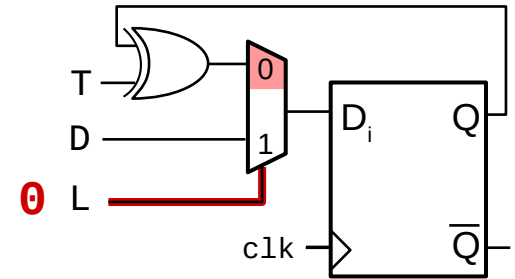
L	D	T	$Q_t$	$Q_{t+1}$
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

T

Si L=0

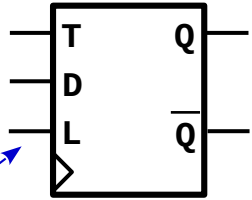


$$D_i = L \cdot D + \overline{L} \cdot (T \oplus Q_t)$$



# Biastable T con carga de datos

Lo que quiero



Carga (load) síncrona

T. funcionamiento

L	D	T	$Q_{t+1}$
0	X	0	$Q_t$
0	X	1	$\overline{Q_t}$
1	0	X	0
1	1	X	1

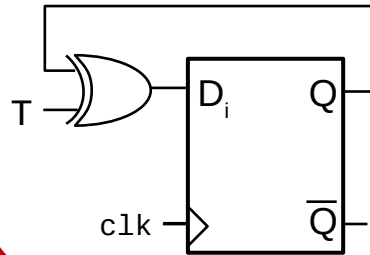
Tabla de transición de estados

L	D	T	$Q_t$	$Q_{t+1}$
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

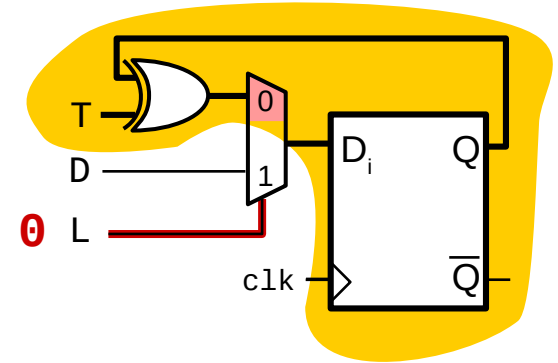
T

Si L=0

Biastable T a partir de D

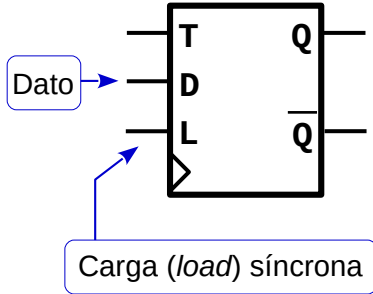


$$D_i = L \cdot D + \overline{L} \cdot (T \oplus Q_t)$$



# Biastable T con carga de datos

Lo que quiero



T. funcionamiento

	L	D	T	$Q_{t+1}$
T	0	X	0	$Q_t$
	0	X	1	$\overline{Q_t}$
D	1	0	X	0
	1	1	X	1

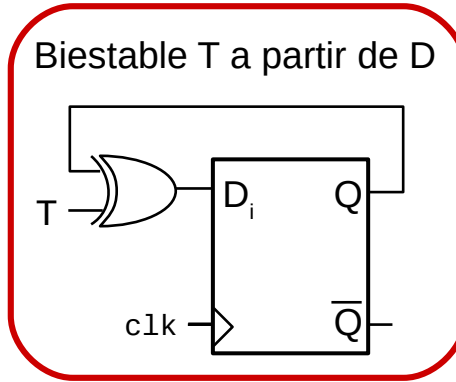
Tabla de transición de estados

L	D	T	$Q_t$	$Q_{t+1}$
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

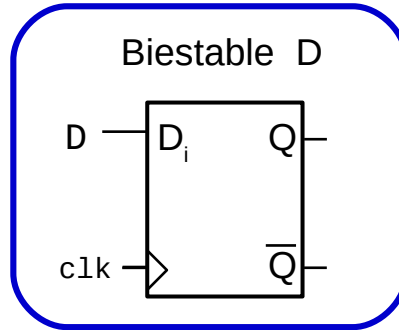
T

D

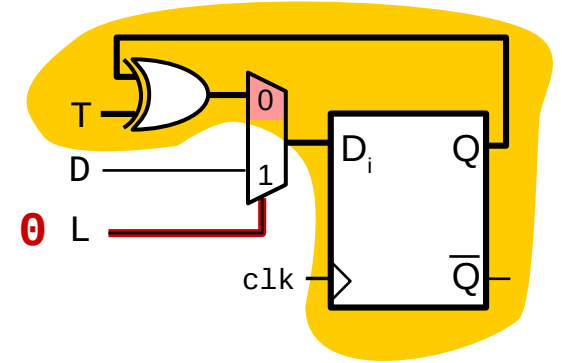
Si L=0



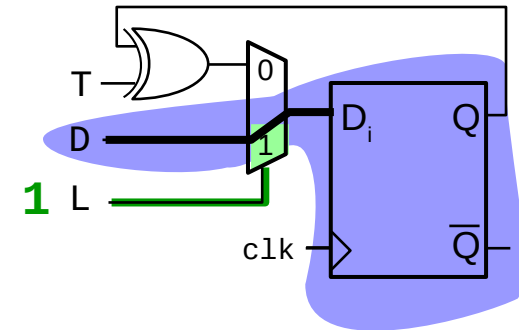
Si L=1



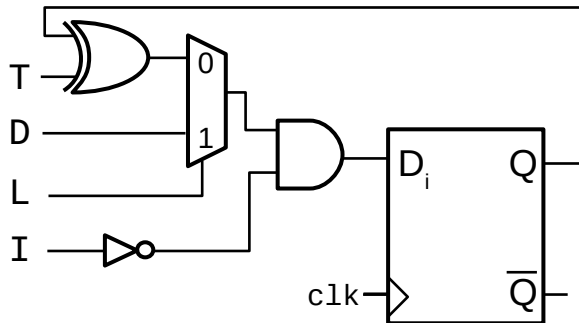
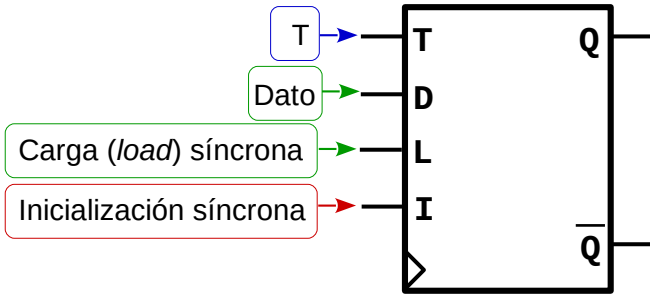
$$D_i = L \cdot D + \overline{L} \cdot (T \oplus Q_t)$$



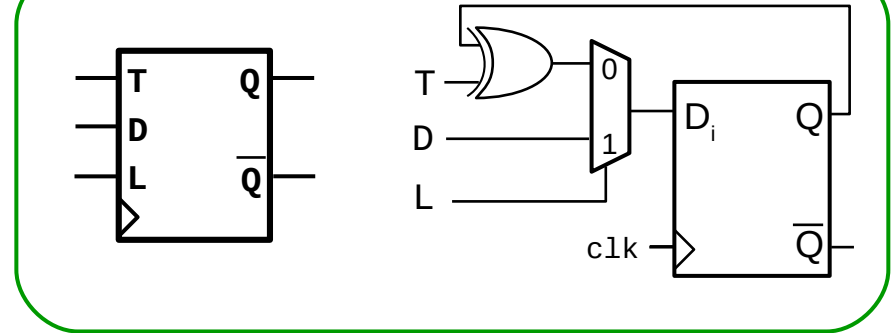
$$D_i = L \cdot D + \overline{L} \cdot (T \oplus Q_t)$$



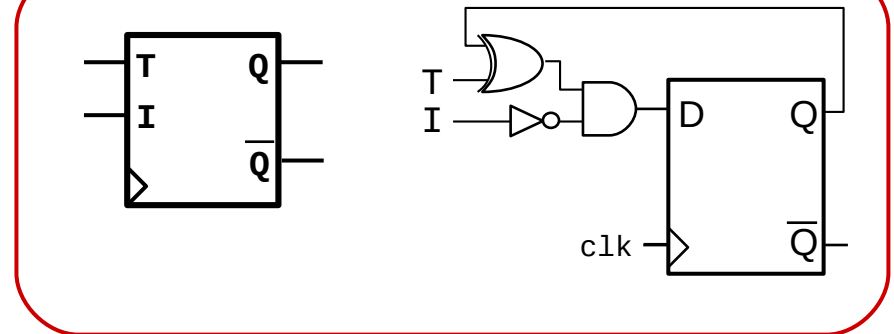
# Biastable T con carga de datos e inicialización



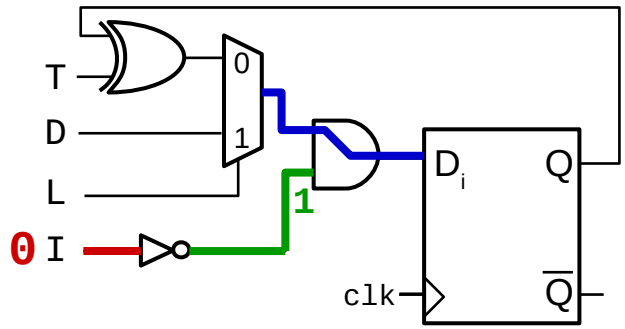
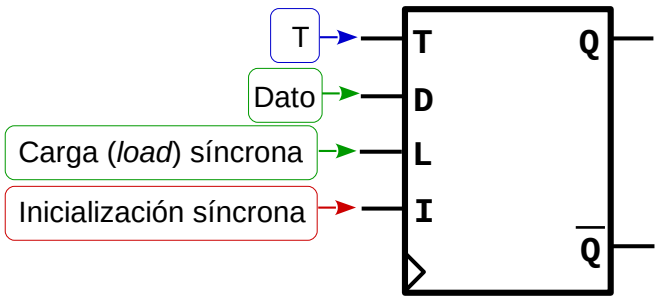
Biastable T con carga síncrona



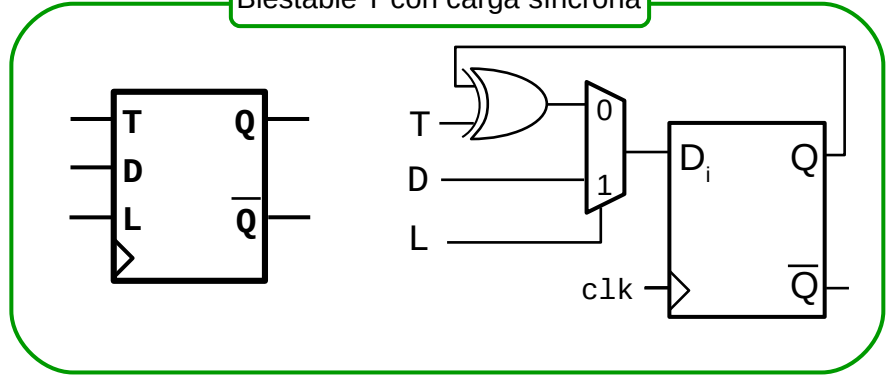
Biastable T con inicialización síncrona



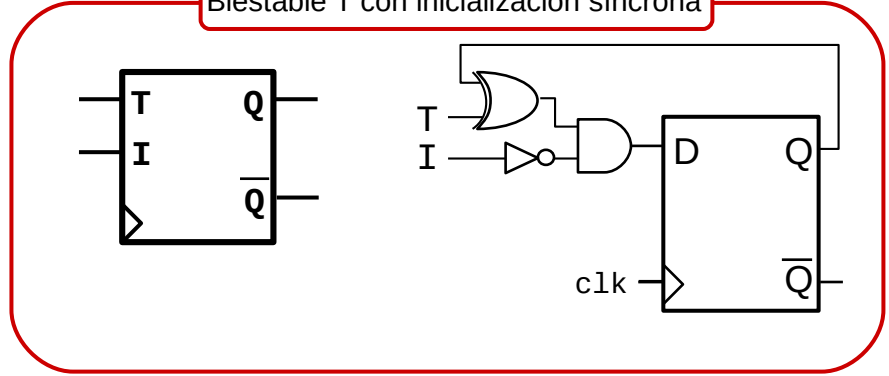
# Biastable T con carga de datos e inicialización



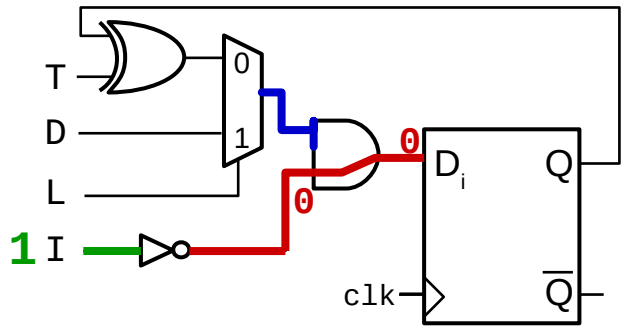
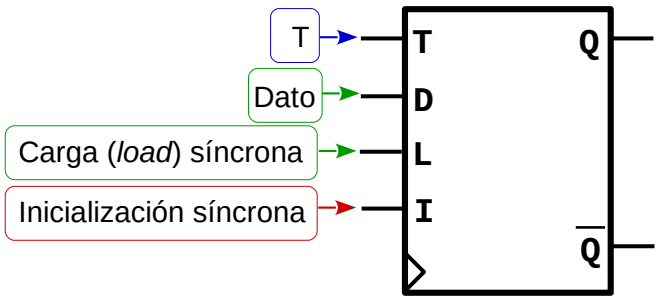
Biastable T con carga síncrona



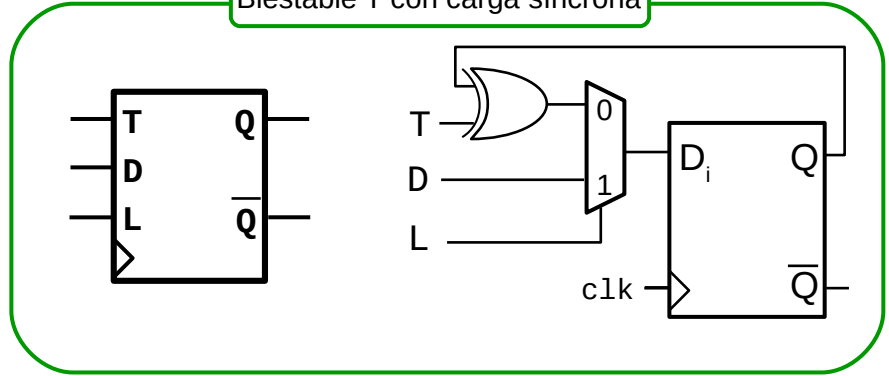
Biastable T con inicialización síncrona



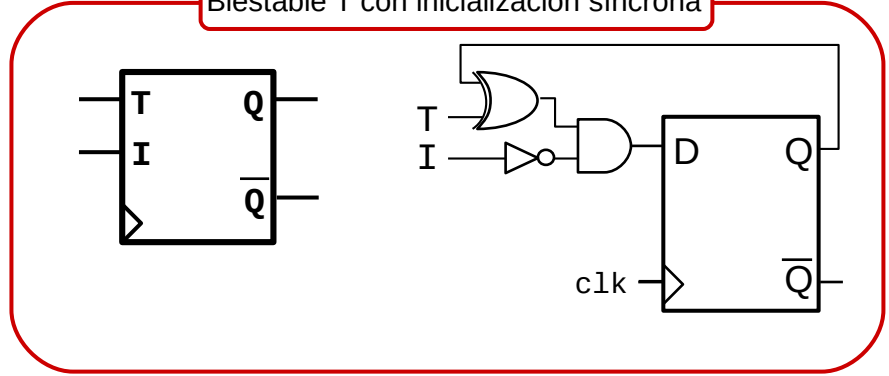
# Biastable T con carga de datos e inicialización



Biastable T con carga síncrona

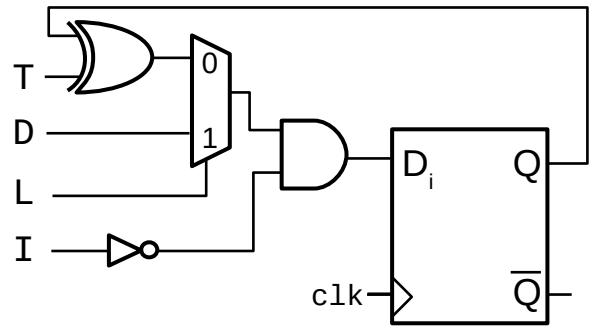
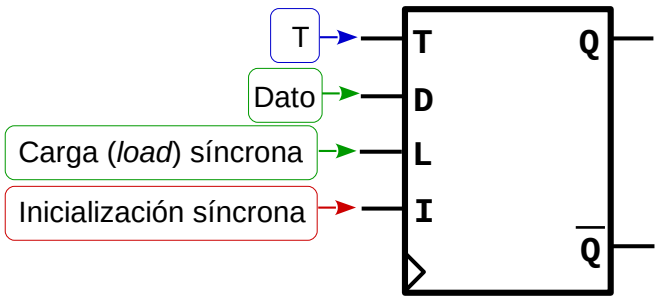


Biastable T con inicialización síncrona

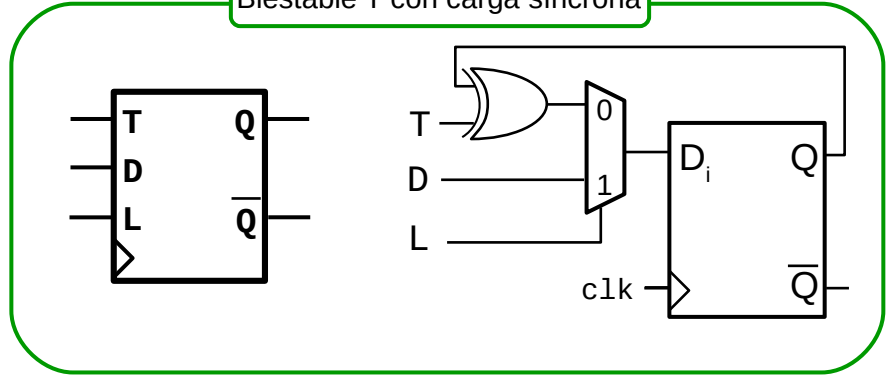




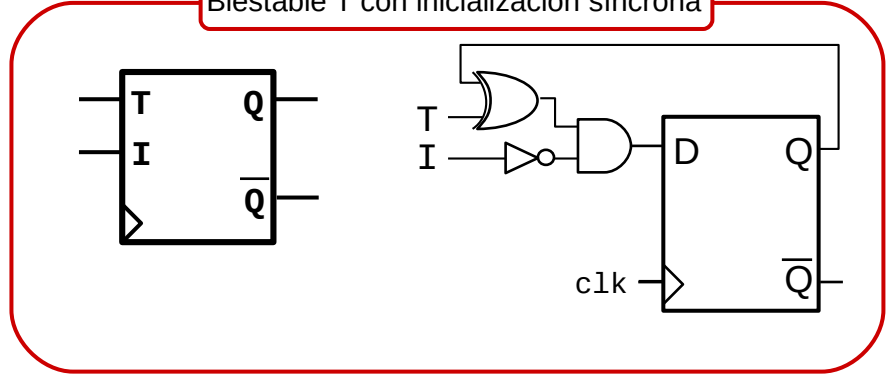
# Biastable T con carga de datos e inicialización



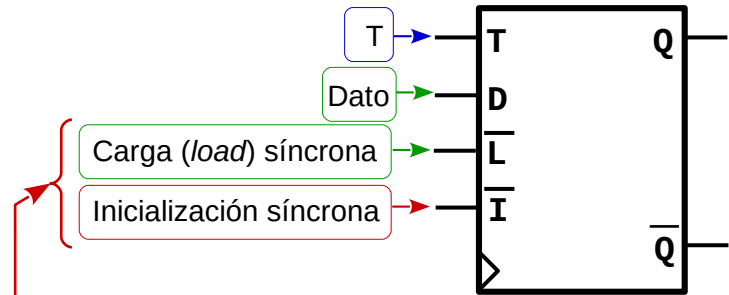
Biastable T con carga síncrona



Biastable T con inicialización síncrona



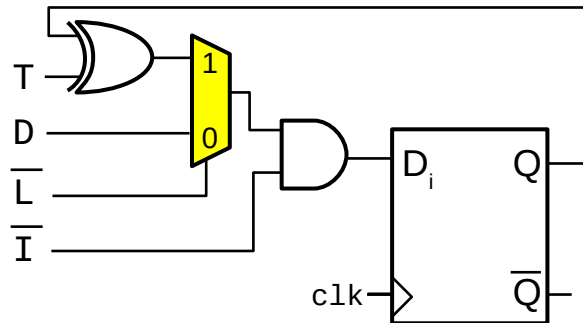
# Biastable T con carga de datos e inicialización



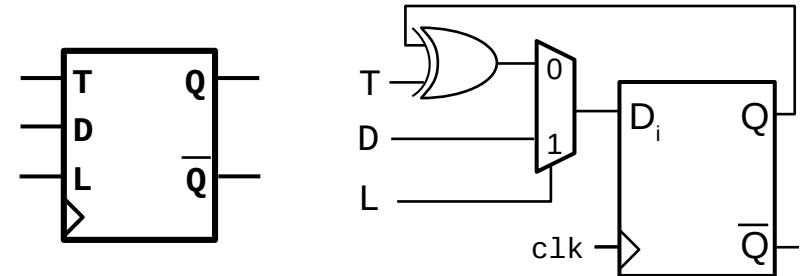
Carga (load) síncrona

Inicialización síncrona

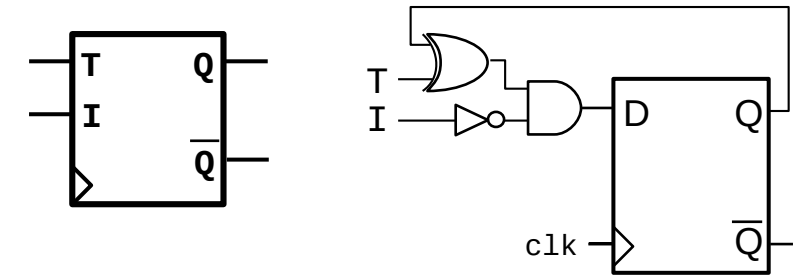
si son activas a nivel bajo



Biastable T con carga síncrona



Biastable T con inicialización síncrona



74x162 Contador BCD, reset síncrono

74x163 Contador HEX, reset síncrono



Esta presentación:

***Ejercicio: Biestable T con carga de datos – Circuitos secuenciales***

cuyo autor es Felipe Machado

está bajo una licencia de Creative Commons Reconocimiento 4.0 Internacional

<https://creativecommons.org/licenses/by/4.0/>

doi: [10.5281/zenodo.3842048](https://doi.org/10.5281/zenodo.3842048)

versión 1.0

Video disponible: <https://youtu.be/YV-jXRsenWs>

