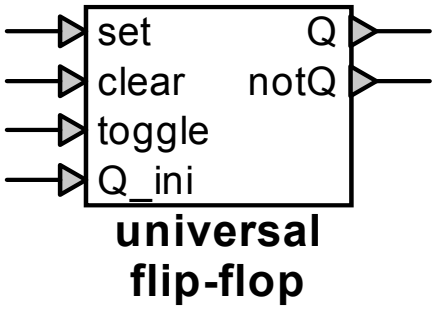
Flip-flop: universal



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1 Description

This device is an implementation of a universal flip-flop with explicit set, clear, and toggle controls.

1.1 Pins

This device has six pins:

pin	*type*	*description*
set	input	set override
clear	input	clear override
toggle	input	toggle override
Q_ini	input	initial Q value
Q	output	Q output
notQ	output	notQ output

1.2 Parameters

The value of the *stepped_mode* flag determines whether the device operates in *stepped* or *ramped* mode. In *stepped* mode (the default for ideal logical signals), the outputs are represented as stepped signals, where changes in value are observed as vertical steps at the time they occur. In *ramped* mode, the value transitions of the outputs are seen as ramps between $t-\Delta t$ and t.

parameter	*description*
stepped_mode	=1 to indicate stepped mode (default) =0 to indicate ramped mode

1.3 Input

The input pins may be connected to any control signals.

Numerical input values are automatically interpreted as logical values by this device, as follows:

input	*converted logical value*	*logical value representation*
value > 0	true	1
value ≤ 0	false	0

The initial value of *Q* must be defined if the device is possibly holding or toggling at *t=0*. When the device operates in clearing or setting mode at *t=0*, the initial value is ignored.

1.4 Output

The outputs are *Q* and its logical inverse *not*Q. Their representation as *stepped* or *ramped* signals is determined by the value given to the parameter *stepped_mode*.

The numerical representation of the output logical values is:

output logical value	*output numerical value*
true	1
false	0

1.5 Representation

The implementation of the model can be inspected by opening the device's subcircuit.

The model applies the following logic for determining its state:

rule sequence	*action*	*output*

if set>0
else if clear>0
else if toggle>0
else
endif
	setting
	clearing
	toggling
	holding
		Q(t) = 1
		Q(t) = 0
		Q(t) = not Q(t-dt)
		Q(t) = Q(t-dt)

if holding at t=0	use Q_ini	Q(0) = Q_ini
if toggling at t=0	use Q_ini	Q(0) = Q_ini