

D-Flip-Flop with Enable and asynchronous Reset

The flip-flop is a basic building block of sequential logic circuits. It is a gate that has two stable states and can store one bit of state information.

This D-Flip-Flop has a D (data) input, a clk (clock) input, an en (enable) input and an R (reset) input and outputs Q and \bar{Q} (the inverse of Q).

This flip-flop is positive edge-triggered. This means that the flip-flop changes output value only when the clock is at a positive edge (or rising clock edge) **and** the input en is active (HIGH/1) **and** the reset input R is inactive (LOW/0). An active R input immediately sets output Q to LOW/0 independently (= asynchronously) from clock's rising edges.

Symbol	Truthtable																																				
	<table><tr><th>R</th><th>en</th><th>D</th><th>clk</th><th>Q^*</th><th>\overline{Q}^*</th></tr><tr><td>1</td><td>-</td><td>-</td><td>-</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td><td>↑</td><td>Q</td><td>\overline{Q}</td></tr><tr><td>0</td><td>0</td><td>1</td><td>↑</td><td>Q</td><td>\overline{Q}</td></tr><tr><td>0</td><td>1</td><td>0</td><td>↑</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td><td>↑</td><td>1</td><td>0</td></tr></table> <p>Q: current value before rising edge of clk. Q^*: next value after rising edge of clk.</p>	R	en	D	clk	Q^*	\overline{Q}^*	1	-	-	-	0	1	0	0	0	↑	Q	\overline{Q}	0	0	1	↑	Q	\overline{Q}	0	1	0	↑	0	1	0	1	1	↑	1	0
R	en	D	clk	Q^*	\overline{Q}^*																																
1	-	-	-	0	1																																
0	0	0	↑	Q	\overline{Q}																																
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0	1	0	↑	0	1																																
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Property	Settings	Meaning
Clock-to-Q	Delays	The Clock-to-Q delay is the delay measured from clk 's rising edge to the output.
Setup-Time	Delays	Setup time is defined as the minimum amount of time before the clk 's rising edge by which the data D must be stable for it to be stored correctly. Any violation in this required time causes incorrect data to be captured and is known as a <i>setup violation</i> which may cause <i>metastability</i> of state and outputs.
