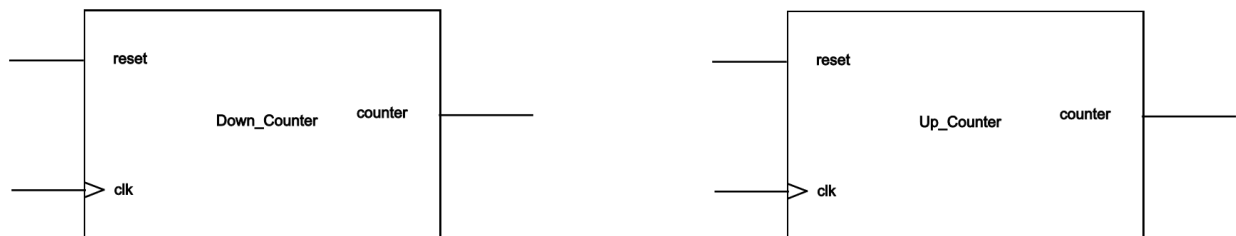# EL6463 Advanced Hardware Design

Lab #2

Name: Chen Shen
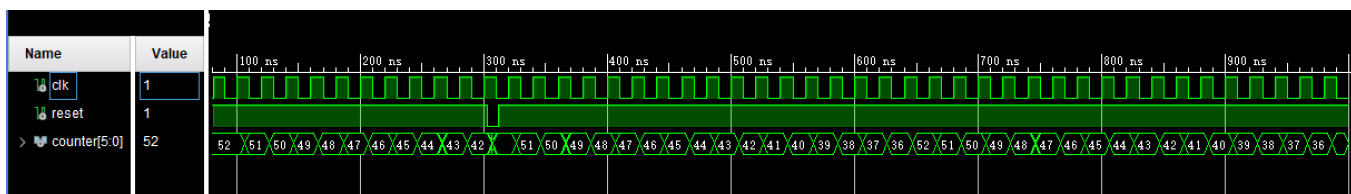
netID: cs5236

Block diagram

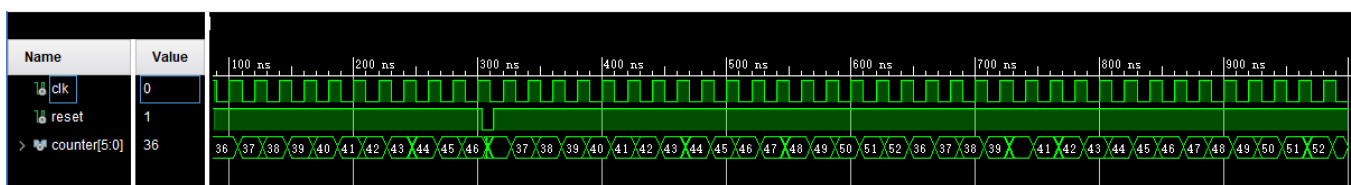In the above shows the block diagrams of a down counter and an up counter.

Notice that this diagram only includes the IO of a counter. We can use D flip-flop or JK flip-flop to implement a counter in gate level.

Functional and timing simulation

Down Counter

Up Counter

Notice that in my test bench, I have already initialized signal `reset` to 0. Thus, I can set the signal `reset` to 1 at the very beginning.

From the figures above, we can see that the two counter keep counting up/down at each positive edge of clock signal `clk`. Each counter counts from one pre-set value to the other pre-set value (in this lab, from 52 to 36 or from 36 to 52). Besides, when the signal `reset` is set to 0, the output `counter` will be reset to the intial value (52 or 36).

Resource utilization

Since the down counter shares a common basic architecture with the up counter, they have the same resource utilization.

	Synthesis stage	Place and Route stage
LUT and FF pairs usage	11	6
IOB usage	8	8
RAM/DSP blocks used (if any)	0	0

Speed of the design

Down counter

Setup		Hold		Pulse Width	
Worst Negative Slack (WNS):	19.018 ns	Worst Hold Slack (WHS):	0.187 ns	Worst Pulse Width Slack (WPWS):	9.650 ns
Total Negative Slack (TNS):	0.000 ns	Total Hold Slack (THS):	0.000 ns	Total Pulse Width Negative Slack (TPWS):	0.000 ns
Number of Falling Endpoints:	0	Number of Falling Endpoints:	0	Number of Falling Endpoints:	0
Total Number of Endpoints	6	Total Number of Endpoints	6	Total Number of Endpoints	6

Up counter

Setup		Hold		Pulse Width	
Worst Negative Slack (WNS):	18.392 ns	Worst Hold Slack (WHS):	0.219 ns	Worst Pulse Width Slack (WPWS):	9.500 ns
Total Negative Slack (TNS):	0.000 ns	Total Hold Slack (THS):	0.000 ns	Total Pulse Width Negative Slack (TPWS):	0.000 ns
Number of Falling Endpoints:	0	Number of Falling Endpoints:	0	Number of Falling Endpoints:	0

Setup		Hold		Pulse Width	
Total Number of Endpoints	6	Total Number of Endpoints	6	Total Number of Endpoints	6

Demo video

https://youtu.be/5N9O-4sxTKQ

Total Number of Endpoints	6	Total Number of Endpoints	6	Total Number of Endpoints	6