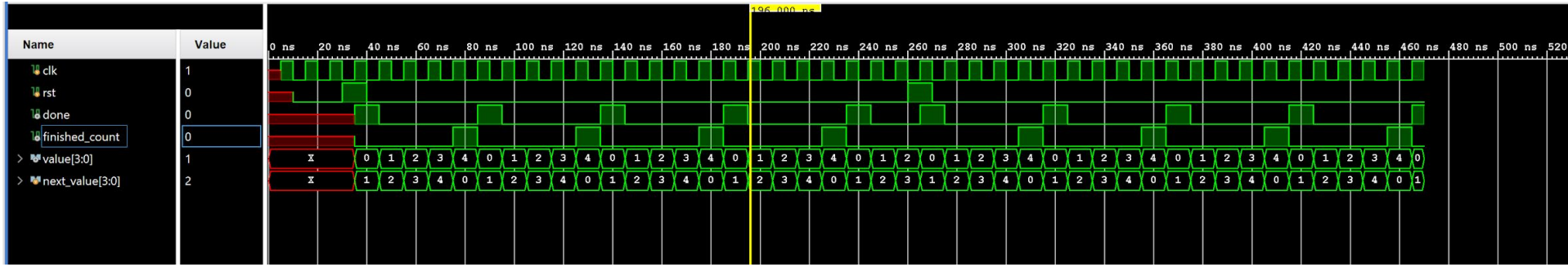
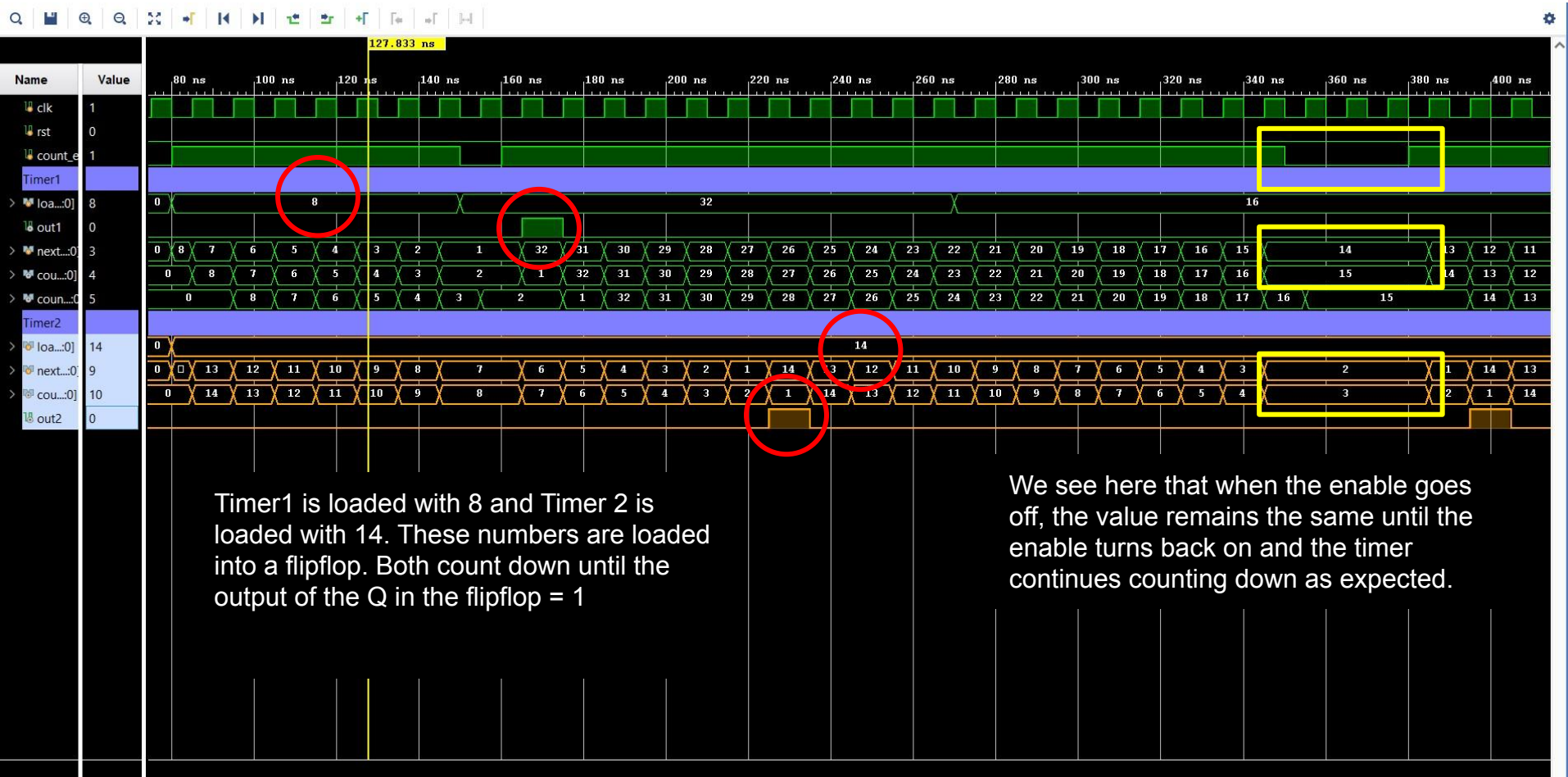
# Beat32




- In this example, we set beat32 to count to 4, therefore, there are 4 clock cycles in between everytime output “done” goes high which is when the value reaches 0. Then it reloads and starts counting again.
- This function works as expected

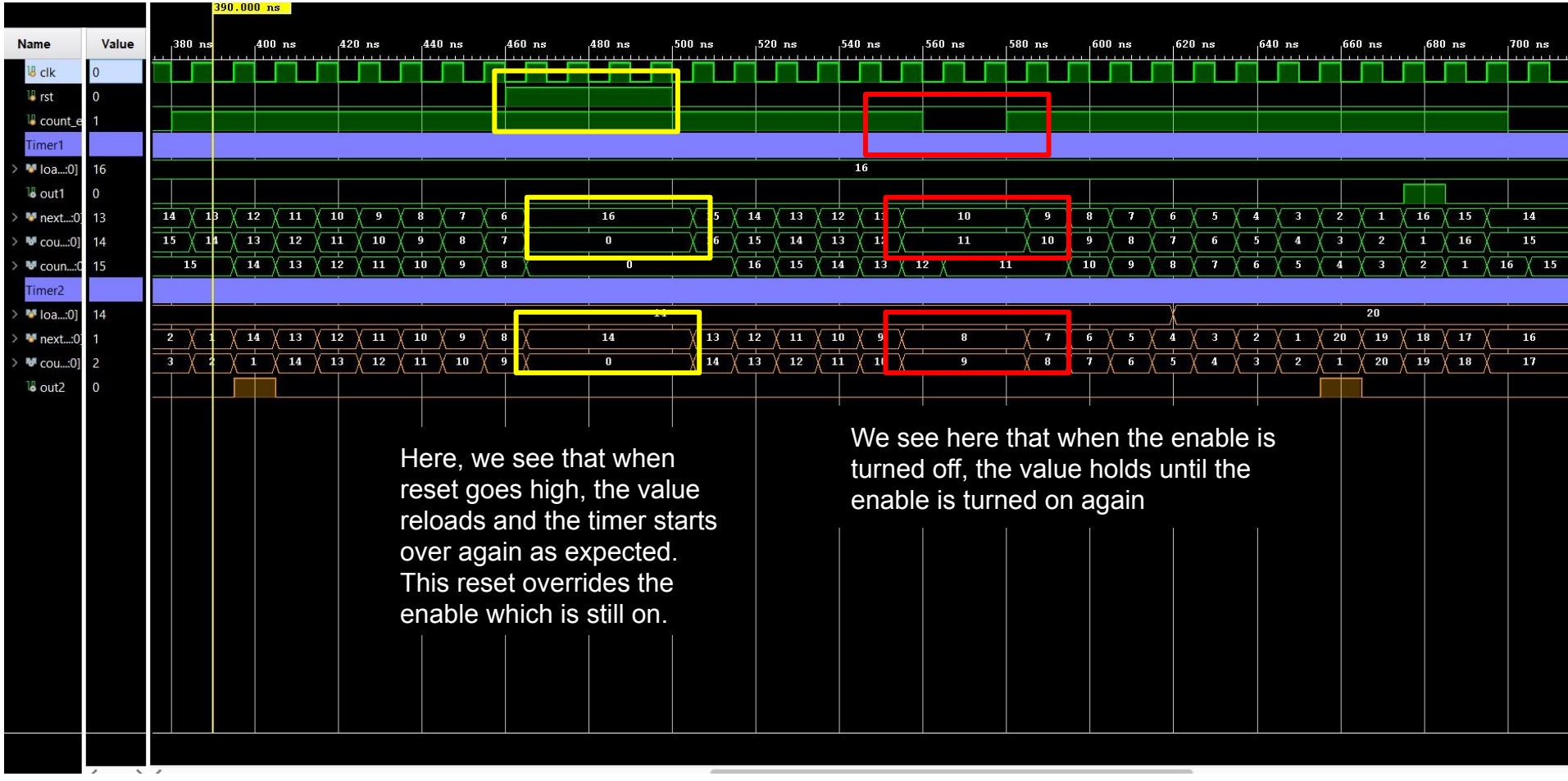
# Timer



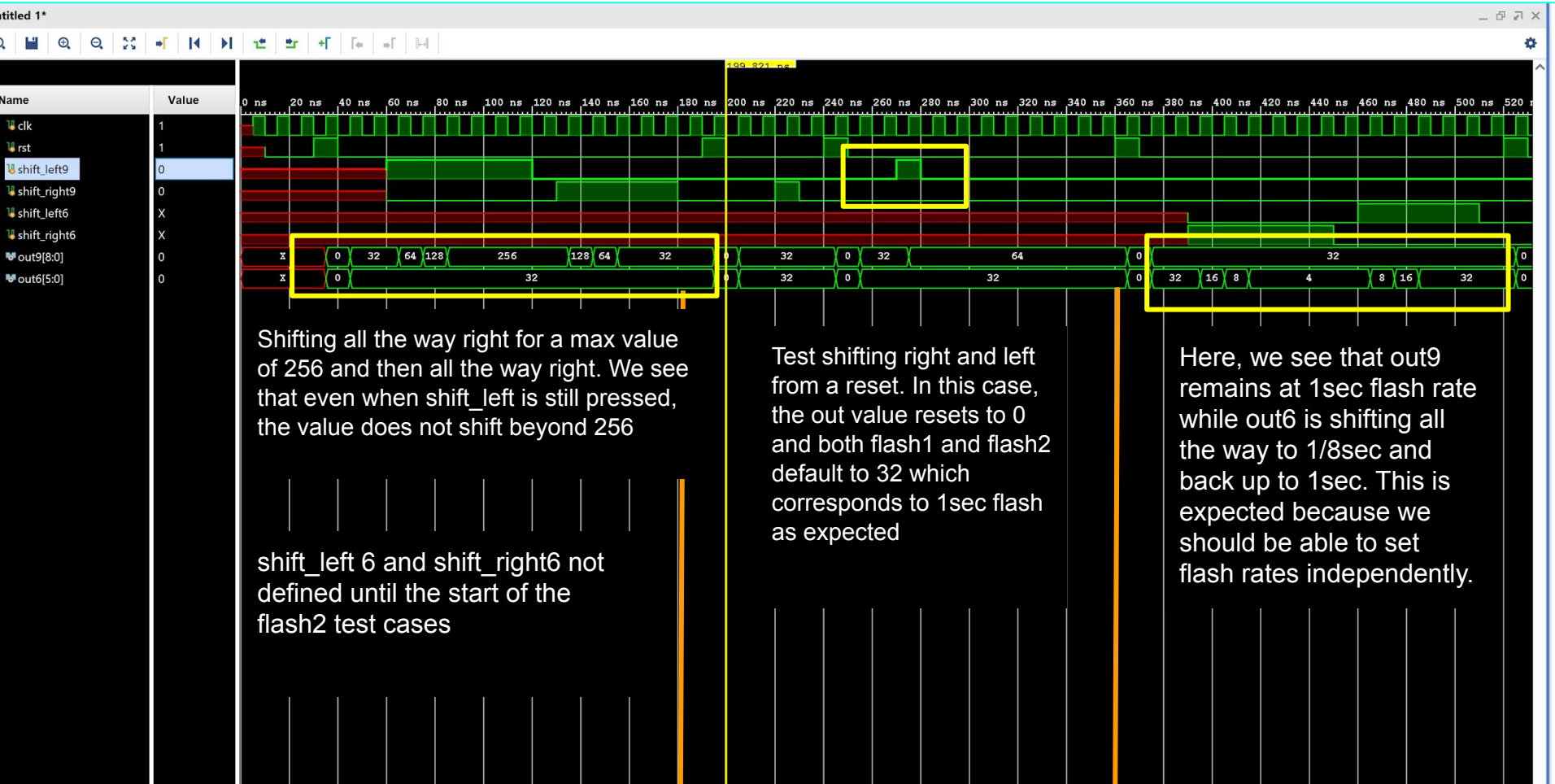

Timer1 is loaded with 8 and Timer 2 is loaded with 14. These numbers are loaded into a flipflop. Both count down until the output of the Q in the flipflop = 1

We see here that when the enable goes off, the value remains the same until the enable turns back on and the timer continues counting down as expected.

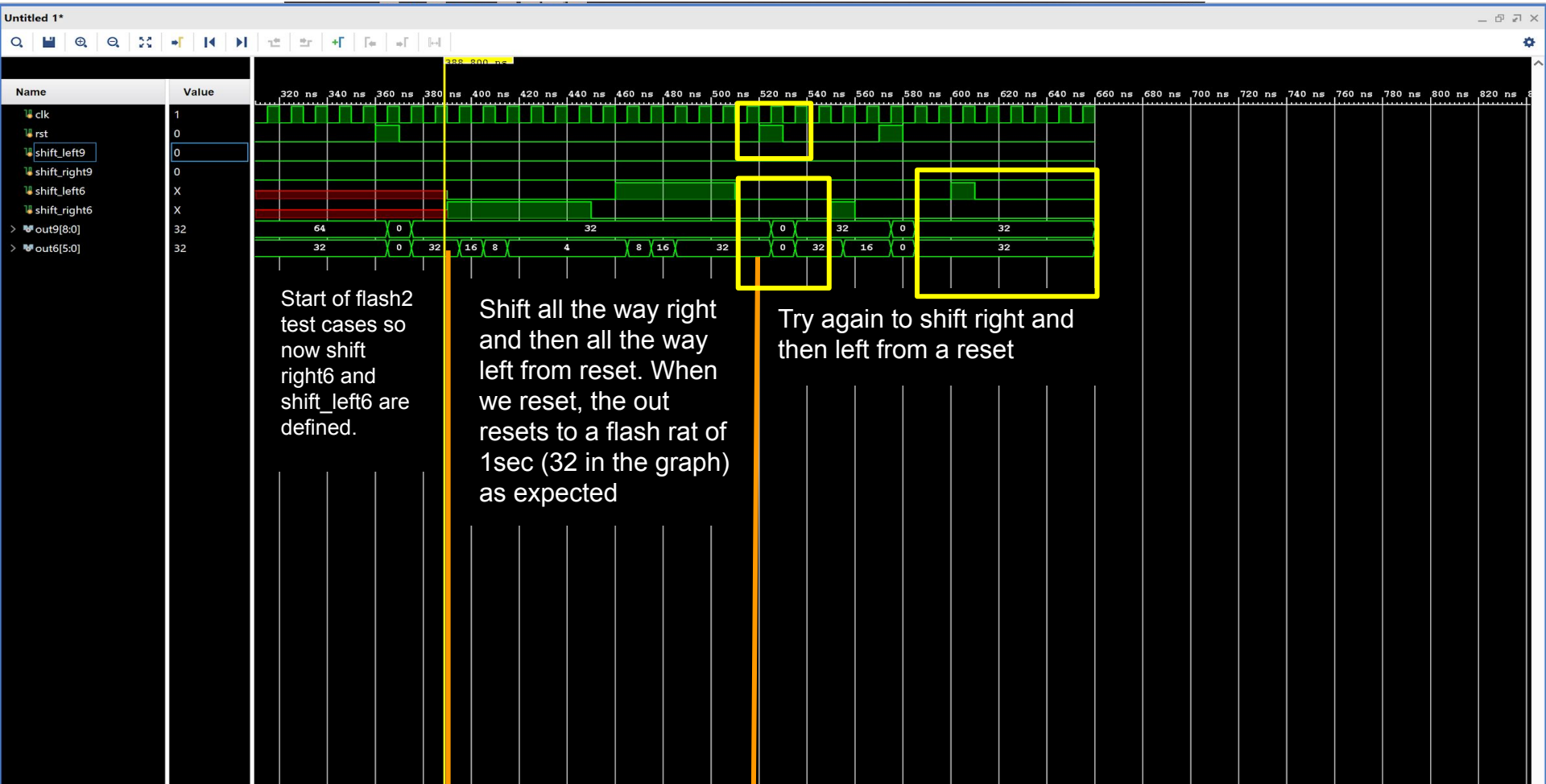
# Timer Continued



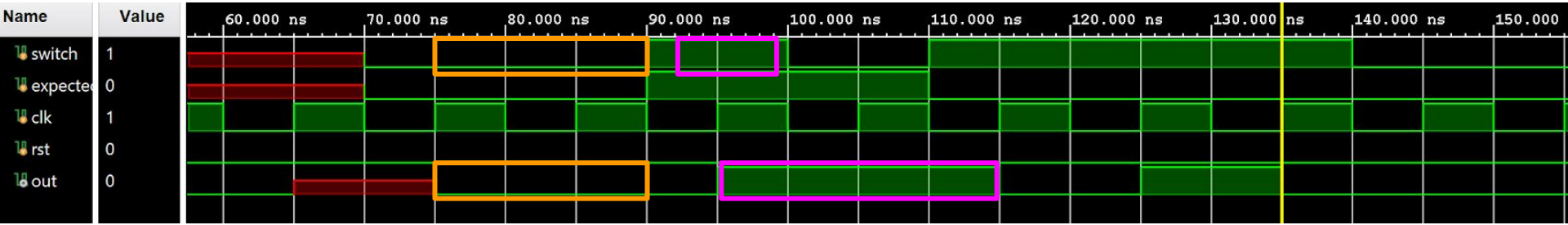
# Shifter for Flash 1 Case



# Shifter Continued



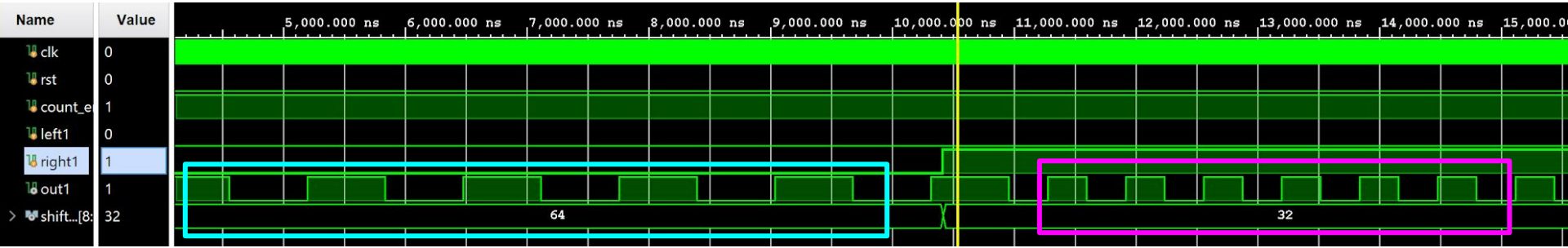
# Blinker




Switch is off, so out stays at 0

Switch turns on so out inverts and becomes 1 until switch turns on again

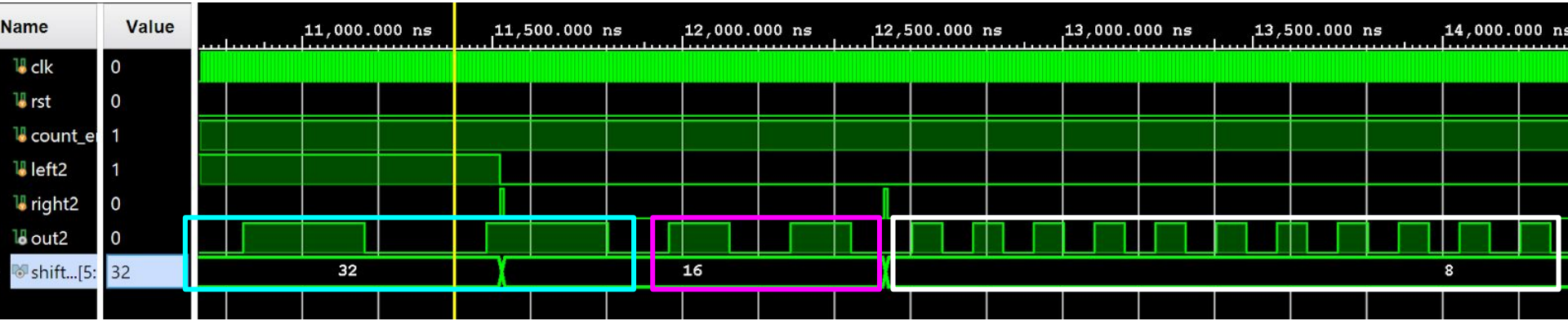
# Programmable_Blinker - FLASH1 case




Note how when right1 is high programmable blinker successfully shifts the blinking rate and we see the rate change from 64 to 32

In the 64 case, the out blinks happen at a slower rate, with the light being on/off for longer then in the 32 case it is on/off for half the time

# Programmable_Blinker - FLASH2 case

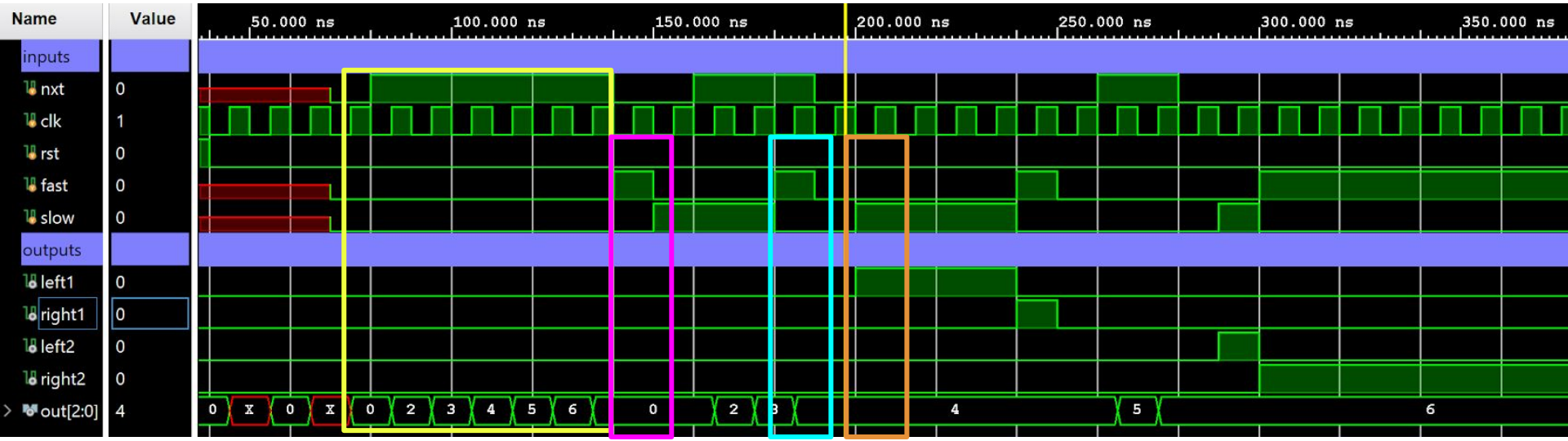



Note how left2 is on but has no effect to the rate. That is because FLASH2 is already at its slowest rate of 1s.

Also note how each time right2 blinks, the rate changes to a smaller number.

As the rate changes from 32 to 16, the period out is on/off for is cut by half and then again cut in half as it goes from 16 to 8.

# Master_FSM




nxt is on so it traverses through the states

fast is on but since the curr state is neither FLASH1 or FLASH2, nothing happens

although fast is on, right1 is low, the state is FLASH1 who starts at 1s and it can not go faster.

slow is on, state is FLASH1, output is left1 high as expected since FLASH1 starts at 1s and can go slower (up to 8s)

STATE_OFF1 = 0*
STATE_ON = 2
STATE_OFF2 = 3
STATE_FLASH1 = 4
STATE_OFF3 = 5
STATE_FLASH2 = 6

*state_off1 used to be defined as 1 but we later changed it and didn't adjust the numbering of the rest

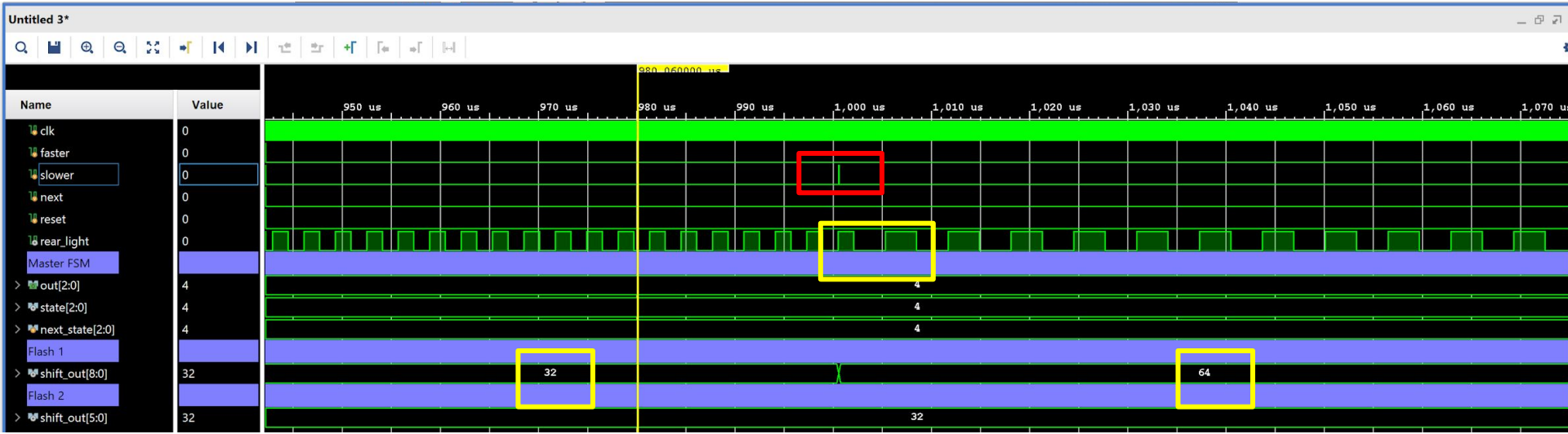
# Bicycle FSM


- This first case is just cycling thru all of the states to make sure they are working properly.
  - In Master FSM we defined State 2 = ON, State 4 = Flash 1, State 6 =Flash 2, and every other state = OFF
  - State 2 is the only state that should cause rear light to go high because it is the 'ON' state.
  - Flash 1 and 2 have an on and off cycle that is too large to be seen in this nanosecond scale therefore they appear to be off in this image. We will test them separately later

- In this next section, we are slowing down Flash1 and checking all of its states. The numbers should increase from 32 to 64 to 128 to 256 is correct.
- At around 240 ns, we begin checking the states for Flash 2. The numbers should go from 32 to 16 to 8 to 4 as we see above
  - We speed them up and slow them back down.
- Outputs are correct

- Finally, we place the blink rates of flash 1 and 2 in a non_default state and run a reset to make sure everything gets reset.
- We see that the state gets reset to 0 which is the first OFF state and the blink rates default to 32 which is 1sec as expected. This means that reset overrides any other signal. For example, faster is still on but reset takes priority
- The behavior is as expected and is fully functional.

# Bicycle FSM - Flash 1




In Master FSM - we defined flash 1 to be output 4. Looking at out from Master FSM, you can see we are currently in state 4/flash 1. If you look at the red square, you can see that the slower button was clicked, and since we are in flash 1, only the flash 1 output changed from 32 to 64, doubling time. After we press slower, Bicycle FSM's output "rear light's" cycle doubles as it should. This behavior continues until you reach the slowest possible rate of 256 in Flash 1. The rear_light changes accordingly as you can see the output of rear_light gets more and more spaced out as we slow the flash rate.

# Bicycle FSM - Flash 1


All cases for Flash 1 displayed.

- First it slows down
- And then it speeds back up as seen in the rear light cycles. The rear light cycle gets increasingly slower and the output is spread apart the most when shift_out = 256 which is the slowest rate as expected. It them speeds back up.

# Bicycle FSM - Flash 2

- Now we are looking at Flash 2, displayed by the output of 6 in Master FSM.
- In this test bench we click **faster** several times, and you can see the rear light beginning to blink at a faster rate which corresponds to the shift_out going from 32 -> 16 -> 8 as expected
    - The top photo is the first picture and the bottom photo the second picture which shows a faster blink rate.

# Bicycle FSM - Flash 2


- Now we are looking at Flash 2, displayed by the output of 6 in Master FSM.
- In this wave form we click **slower** several times, and you can see the rear light beginning to blink at a slower rate.
- This is the expected behavior as the shift_out for Flash 2 is also changing its rate going from 4 to 8 to 16 to 32 which corresponds to 1/8sec to 1sec. Rear light changes accordingly with 1sec being the slowest rate and thus the blink rate is spread out the most

# Lab3_Top