LAB 1 – SIMULATION

Lớp L04 - Nhóm 03

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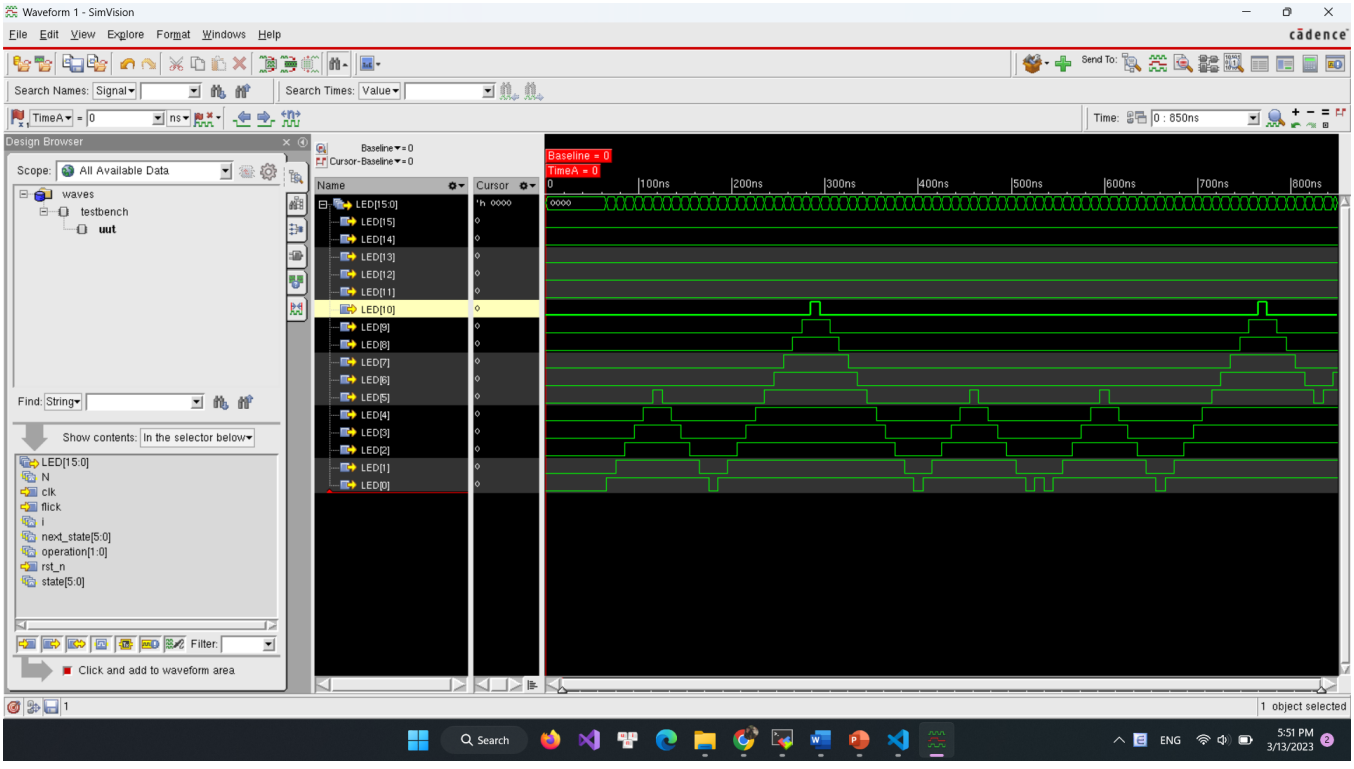
Within the testbench file BoundFlasher_tb.v, code for generating test signal pattern is divided into 3 seperate section, with each corresponding to a specific test of the BoundFlasher module.

1. Normal operation without flick signal interruption
2. Flick active at the reset point of STATE_UP_1_10, testing both condition of 5 lights and 10 lights
3. Flick active at the reset point at state STATE_UP_6_16 and state STATE_DOWN_9_5, testing both condition of 5 lights and 10

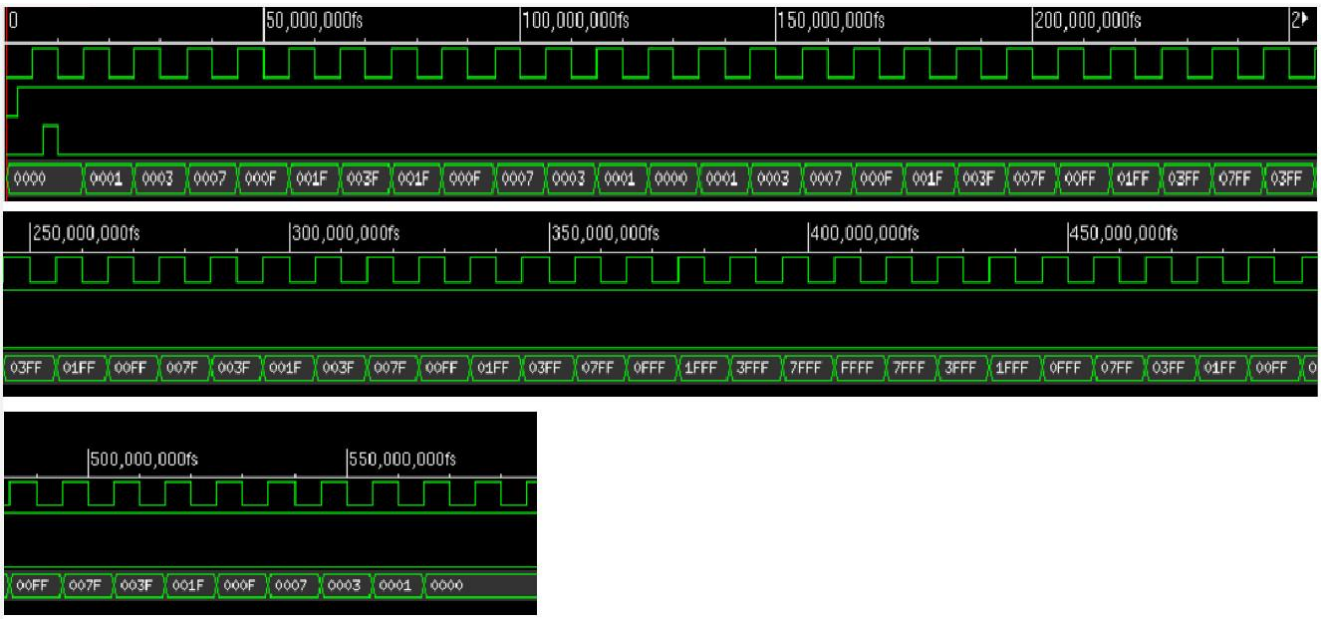
I. Answer for question:

1. Simulation WaveForm on Xcelium:



*) WaveForm Detail:

*)Testcase Normal Flow:



2. Code Testbench :

a. File Testbench:

```
module
boundFlasher_tb;

                    parameter HALF_CYCLE = 5;
                    parameter CYCLE = HALF_CYCLE * 2;

                    reg flick, clk, rst;
                    wire [15:0] led;

                    boundFlasher dut(.flick(flick), .clk(clk), .rst(rst), .LEDs(led));

                    //generate clock
                    always begin
                      clk = 1'b0;
                      #HALF_CYCLE clk = 1'b1;
                      #HALF_CYCLE;
                    end

                    initial begin
                      rst = 0;          // second 0
                      flick = 0;               // second 0
                      #2 rst = 1;       // second 2


                          //INITIAL
                          //STATE_1: 60
                          //STATE_2: 60
                          //STATE_3: 110
                          //STATE_4: 60
                          //STATE_5: 110
                          //FINAL: 160

                      // Test case :
                      #5 flick = 1;     // second 7           (Testcase 1) Normal flow
                      #3 flick = 0;     // second 10

                      #580 flick = 1; // second 590   (Testcase 6) Flick signal to repeat
                  the process
                      #3 flick = 0;     // second 593

                          #173 flick = 1; // second 766 (Testcase 2) Flick signal at L5 in
                  state 3
                          #3 flick = 0;
```

```
        #139 flick = 1; //second 908 (Testcase 8) Flick signal at
between L5 and L10 in state 3
        #3 flick = 0;

        #25 flick = 1; // second 936 (Testcase 3) Flick signal at L10 in
state 3
        #3 flick = 0;

        #288 flick = 1; //second 1227 (Testcase 4) Flick signal at L5 in
state 5
    #3 flick = 0;

        #70 flick = 1; //second 1300 (Testcase 5) Flick signal at L10 in
state 5
        #3 flick = 0;

        #343 flick = 1; // second 1646     (Testcase 6) Flick signal to
repeat the process
        #3 flick = 0;

        #100 flick = 1; // second 1749 (Testcase 7) Flick signal at any
time slot (not kickback point in turning off leds state)
        #3 flick = 0;

        #100 rst = 0; // second 1852 (Testcase 9) Reset signal at any
time slot
        #3 rst = 1;



        #3 flick = 1; //second 1858 (Testcase 6) Flick signal to repeat
the process
        #3 flick = 0;

        #55 flick = 1; //second 1916 (Testcase 10) Flick signal at
initial state
        #3 flick = 0;

        #167 rst = 0; flick = 1; // second 2086 (Testcase 11) Reset
signal with flick signal at kickback point in turning off leds state
        #3 flick = 0;
        #3 rst = 1;
```

```
    ////////////////////////////
    #(CYCLE*45) $finish;
  end

  // To see waveform in online EDA playground only
//  initial begin
//    $dumpfile("debug.vcd");
//    $dumpvars;
//  end
  /////


initial begin
    $recordfile("waves");
    $recordvars("depth=0", boundFlasher_tb);
end


endmodule
```

***) Explain:**

+) **On Normal Flow**, display leds according to the normal patten without reset flick signal (flick = 1 in the entrire run).

+) **Flick signal at L5 in state 2,** When the kickback point L5 is off at state 2 and if flick signal triggers, system goes back to the previous state (state 1), turning on leds to L15.

+) **Flick signal at L5 in state 4**, When the kickback point L5 is off at state 2 and if flick signal triggers, system goes back to the previous state (state 3), turning on leds to L10.

+) **Flick signal at L0 in state 4,** When the kickback point L0 is off at state 2 and if flick signal triggers, system goes back to the previous state (state 3), turning on leds to L10.

+) **Flick signal to repeat the process**, after a complete flow, flick signal to check the process can be repeated from state 1 not state 6.

+) **Flick signal at any time slot (not kickback point in turning off leds state)**, If flick signal takes effect in those states then the code is wrong, else then everything is OK.

+) **Flick signal at between L5 and L0 in state 4, Between the kickback point L5 and L0,** trigger flick signal to test if there is any state transition, if yes, then the code is wrong, else then the code working normally.

+) **Reset signal at any time slot, whenever reset signal is 0**, the system reset immediately to the Initial State, all leds are off.

+) **Flick signal at final state**, The kickback point inactive at final state

+) **Reset signal with flick signal at kickback point in turning off leds state,** Both reset signal and flick signal trigger at the same time, system must go back to Initial state.