

Generating 25% Duty Cycle Clock with 50% Frequency

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Objective - To design a synchronous 25% duty-cycle clock generator with 50% frequency that produces a clock HIGH for exactly one input cycle and LOW for three cycles, using Verilog in eSim. Applications include clock gating, sampling systems, and power-efficient designs.

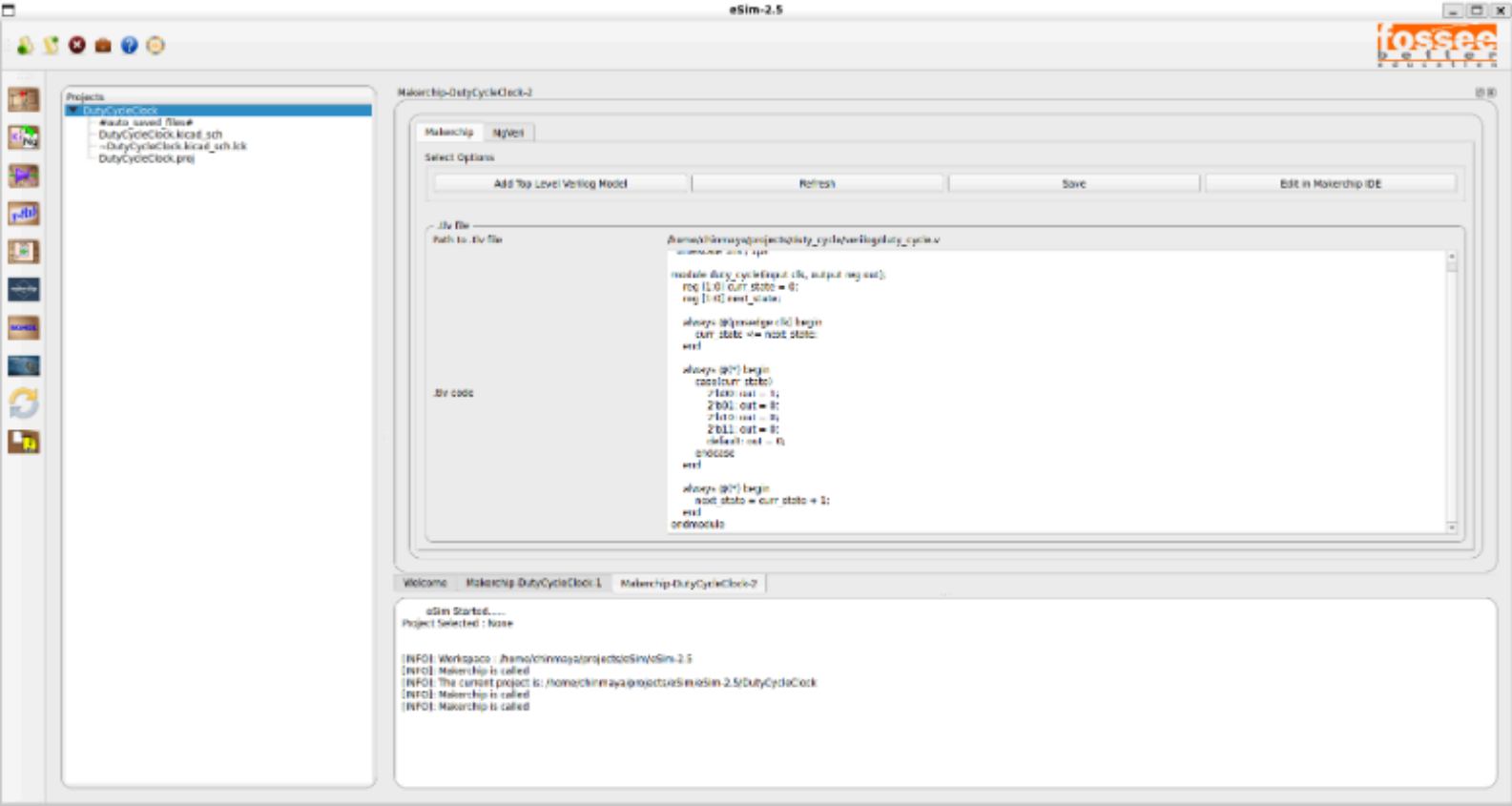
I. Circuit Details

The circuit is based on a 2-bit counter implemented with two D flip-flops. The outputs of the flip-flops represent the current state, and combinational logic generates the next state. A 4-to-1 multiplexer is used to produce the output HIGH for state 00 and LOW for all other states.

- Sequential block: 2-bit counter using D flip-flops with asynchronous reset.
- Combinational block: Next-state logic using addition.
- Output block: 4-to-1 multiplexer generating the 25% duty-cycle output.

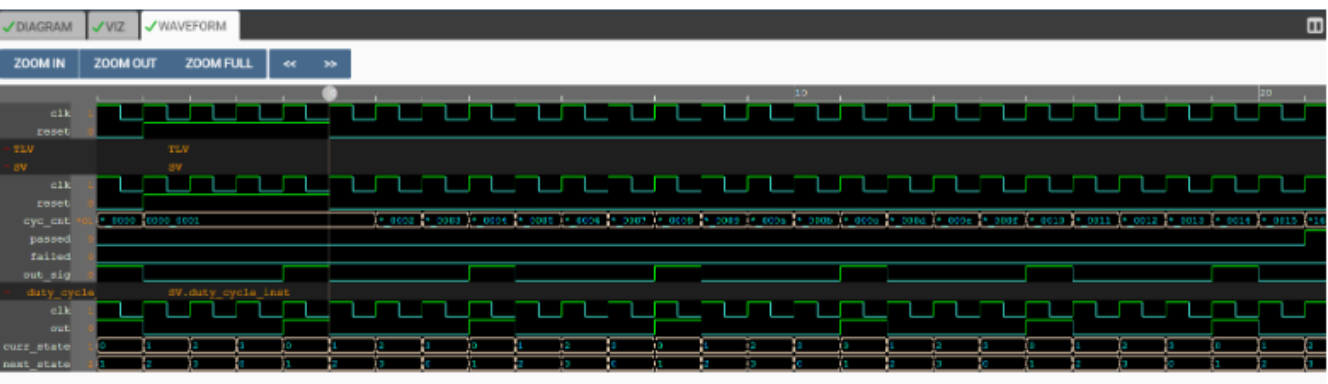
II. Simulation Results

Simulation performed using Makerchip IDE using eSim. Output waveform demonstrates the correct 25% duty cycle (1 HIGH, 3 LOW).



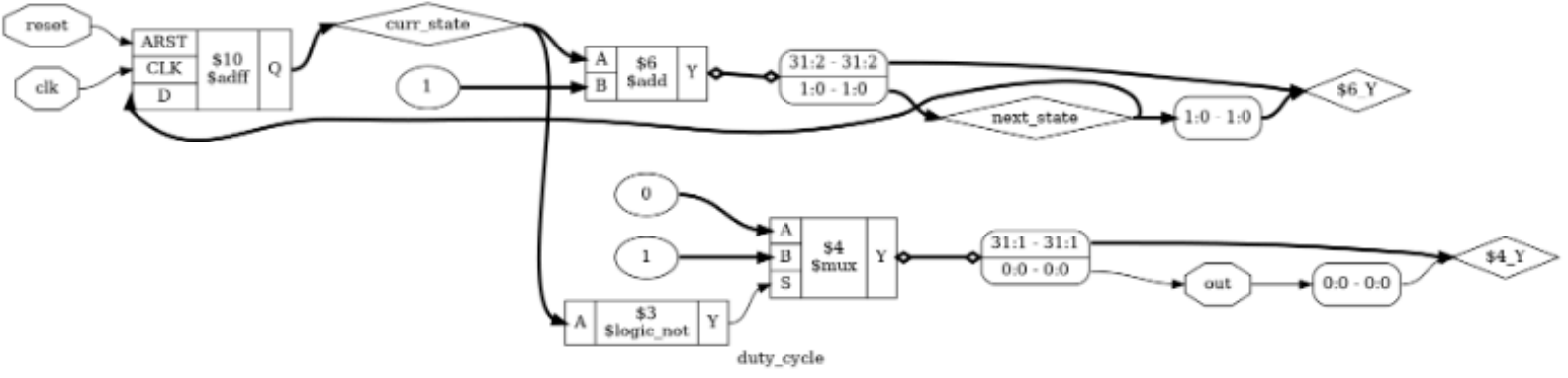
```
1  \TLV_version 1d: tl-x.org
2  \SV
3  /* verilator lint_off UNUSED*/ /* verilator lint_off DECLFILENAME*/ /*
4
5  //Your Verilog/System Verilog Code Starts Here:
6  `timescale 1ns / 1ps
7
8  module duty_cycle(input clk, output reg out);
9      reg [1:0] curr_state = 0;
10     reg [1:0] next_state;
11
12     always @(posedge clk) begin
13         curr_state <= next_state;
14     end
15
16     always @(*) begin
17         case(curr_state)
18             2'b00: out = 1;
19             2'b01: out = 0;
20             2'b10: out = 0;
21             2'b11: out = 0;
22             default: out = 0;
23         endcase
24     end
25
26     always @(*) begin
```

```
26     always @(*) begin
27         next_state = curr_state + 1;
28     end
29 endmodule
30
31 //Top Module Code Starts here:
32 module top(input logic clk, input logic reset, input logic [31:0] cyc,
33 //The $random() can be replaced if user wants to assign values
34     logic out_sig;
35
36     duty_cycle duty_cycle_inst(
37         .clk(clk),
38         .out(out_sig)
39     );
40
41     always_ff @(posedge clk) begin
42         if (reset) begin
43             passed <= 0;
44             failed <= 0;
45         end else begin
46             if (cyc_cnt > 20) begin
47                 passed <= 1;
48                 failed <= 0;
49             end
50         end
51     end
52 endmodule
```



III. Netlist

Synthesis done using Yosys.



IV. Conclusion

The design successfully implements a 25% duty-cycle clock generator with 50% frequency. Simulation results match expected outputs, and the design is verified using Yosys synthesis. The circuit is compact and suitable for integration in larger digital systems requiring precise timing control.

GitHub Repository:
https://github.com/chinmaya24163/duty_cycle

REFERENCES
<https://patents.google.com/patent/US8442472B2/en>

README.md:
https://github.com/chinmaya24163/duty_cycle/blob/main/README.md

