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EE 220
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Lab 06: Oscilloscope/Logic Analyzer

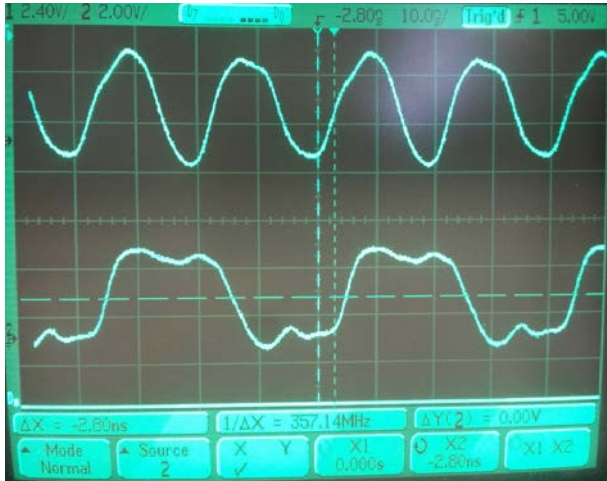
Toggle circuit Verilog code

```
// A D flip flop
module FF_DC(q, clk, clr, d);
    input clk, clr, d;
    output reg q;

    always @(posedge clk)
        if(clr)q<=0;
        else q<=d;
endmodule
```

```
// Toggle circuit
module toggle(q_out, clk_out, g_clk, clr);
    input g_clk;
    input clr;
    output q_out;
    output clk_out;
    wire q_not;
    // read from the output, huh
    not(q_not, q_out);
    // Not quite sure how buf works
    buf(clk_out, g_clk);
    FF_DC flip(q_out, g_clk, clr, q_not);
endmodule
```

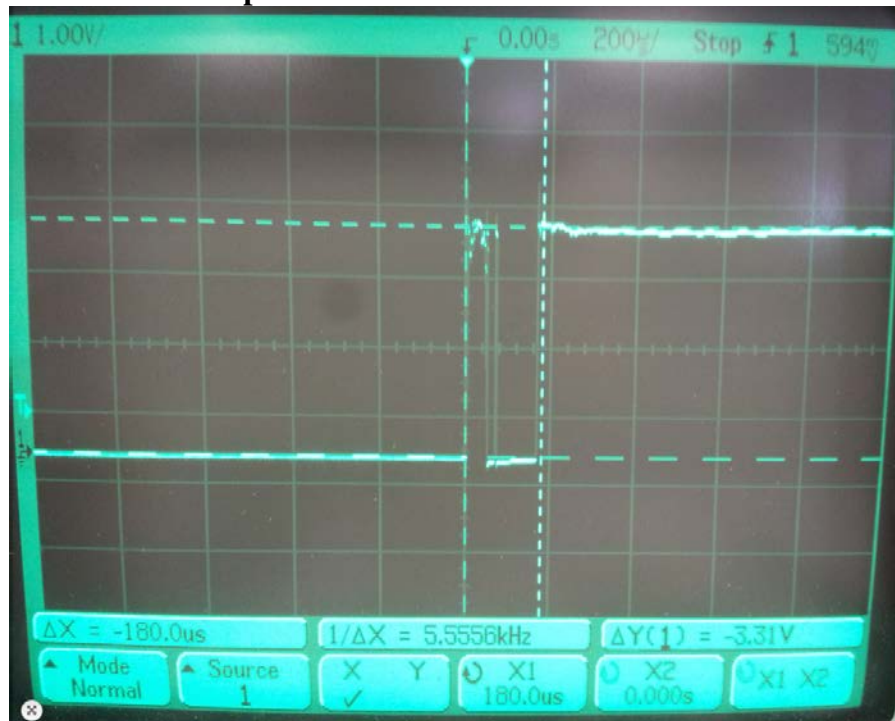
Toggle Circuit screen capture



Toggle circuit question and answer- Why are the waves not square?

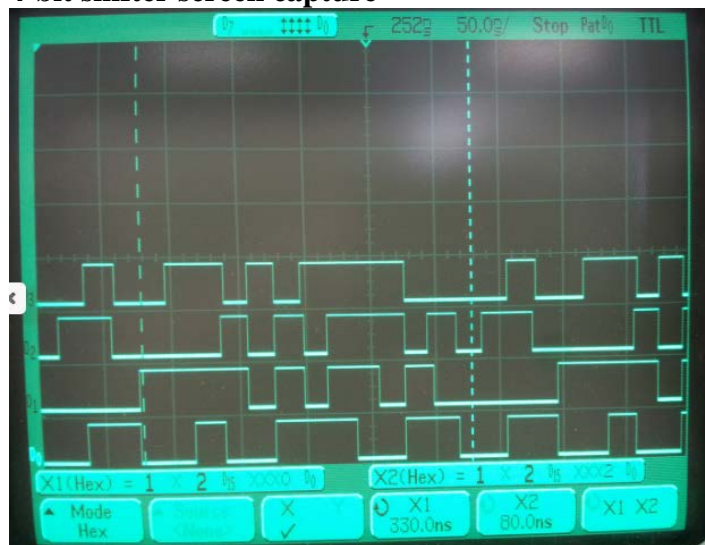
Because outputting perfect square waves is not only impossible, it is useless for a digital device like the FPGA we are using. When we put cutoffs on the wave, and consider everything higher than the cutoff to be '1' and everything lower to be a '0', then we get our nice digital toggle signal. The end.

Bounce screen capture



Bounce circuit settling time: 180 us

4-bit shifter screen capture



4-bit shifter pattern of values
04D12AB6879FEC35

Anomalies

The first breadboard I tried to do the bounce circuit on didn't have any power going to VCC. So I had to change that. Also, when connecting up the wires for the 4-bit shifter, I initially could not get any signal on D3. But I got it.