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Lab 6 – Oscilloscope/Logic Analyzer

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Procedure

Oscilloscope tutorial-

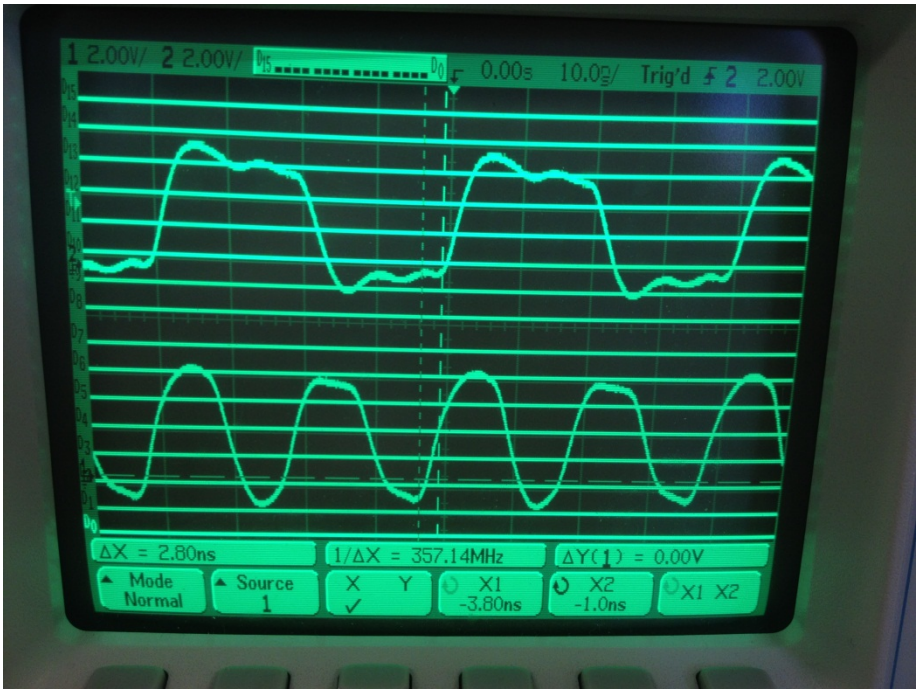
I turned on the oscilloscope and just read the instructions for the oscope. If I need to learn how anything works I can hold the button and get help on it.

Toggle Circuit-

1 , 2.) I did the toggle circuit tutorial. I made the Verilog code for the toggle circuit and used the buffer function in Verilog so that the clock would work with the board. I then used the O-scope to capture the waveforms of Q and CLK signals as x and y respectively. Here is the code:

```
module flipflopD(
   input d,
   input clk,
   input clr,
   output reg q
   );

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

endmodule

module toggle_circuit(
   input gclk,
   input clr,
   output qout,
   output clk_out
   );
          wire qnot , buffer;
                    not(qnot , qout);
                    buf(clk_out, gclk);

          flipflopD FF_DC(qnot , gclk , clr , qout);

endmodule
```

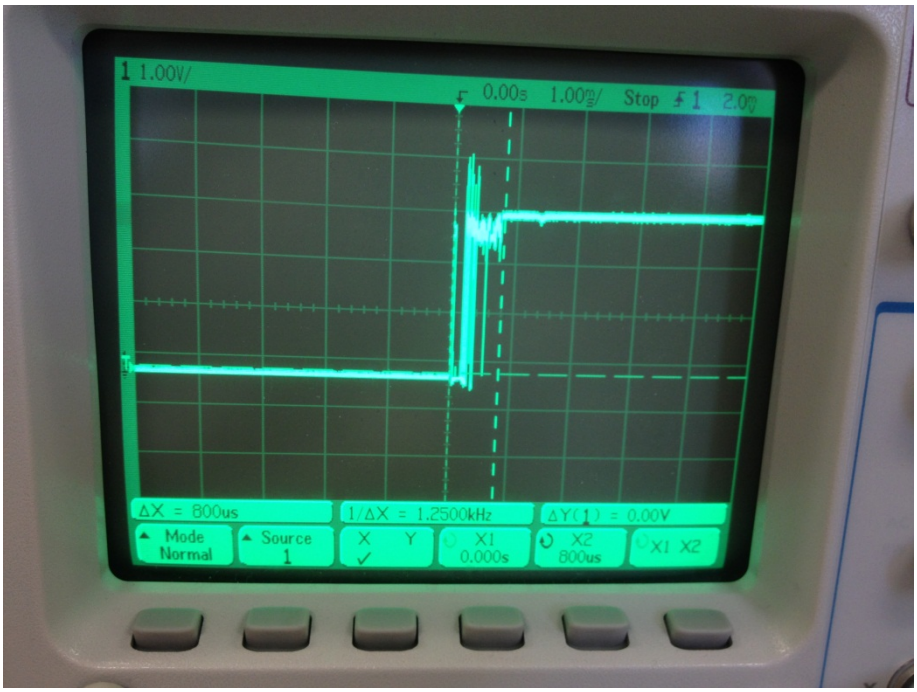
Below is a screenshot of the signals. Notice that the difference in the rising edge of the clock is 2.8 ns ahead of Q.



-in the picture I set the cursors at the beginning of the rising edge so that way I could find the delay between the clock and the change

3.) The o-scope does NOT have square waves because it takes a while for the transistors to change. Even though this is a digital circuit on a large scale, it is still analog.

4.)I set up a bounce circuit to determine the bounce time. I measured 800 us of bounce time. The picture is below:

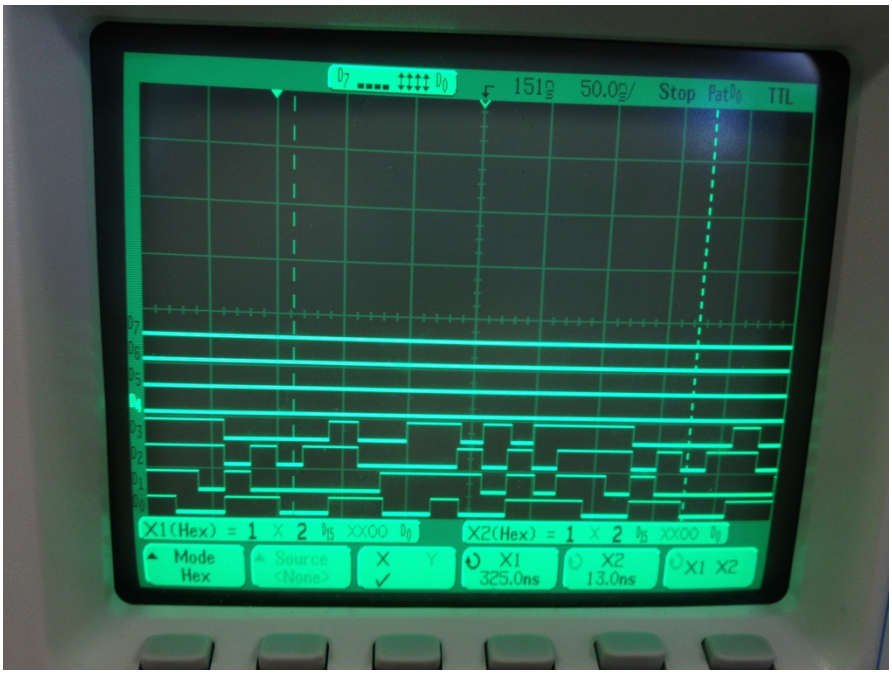


Logic Analyzer

4-bit shift circuit

Below is the recorded sequence. The pattern is over an interval of 16 changes in the outputs (of about 300 ns)

04D12AB6879FEC35

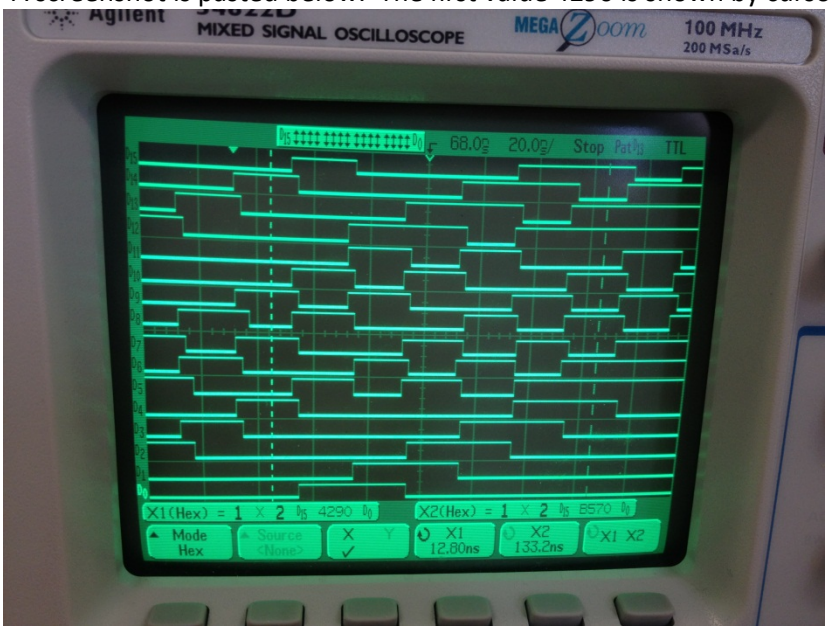


16-bit shifter

These are the first four HEX values in the sequence:

4290
8521
1A43
34A6
694C

-A screenshot is pasted below. The first value 4290 is shown by cursor X1

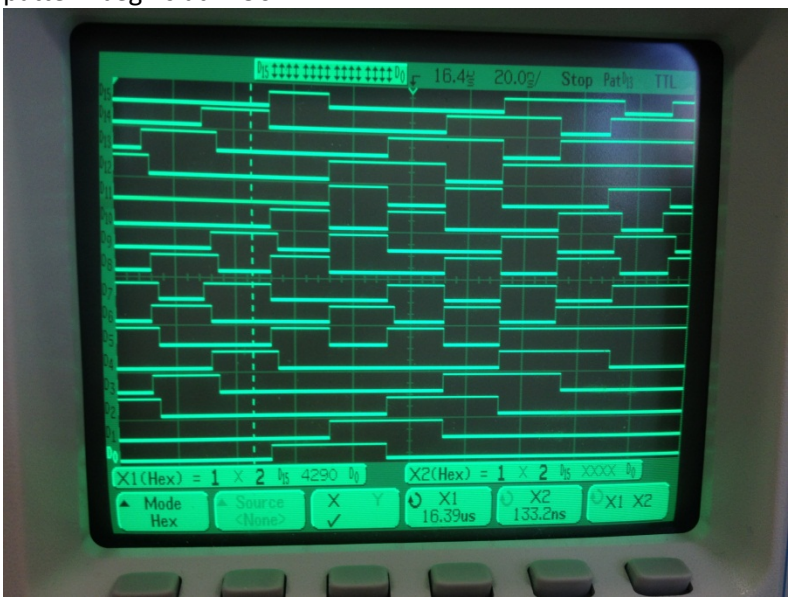


The pattern after 990ns:
0B6B
16F6
2DED
5BFA

-The time starts at 990 ns. Cursor X1 shows the first hex number of the pattern

The pattern after 16.38us (note that it is the same as the initial trigger pattern)
4290
8521
1A43
34A6
694C

-This is a screenshot at 16.38 us. The cursor X1 shows the hex value at that time, and shows that the pattern begins at 4290.



Since the pattern repeats after a long time, I will take some average times of each change in pattern to approximate. Each step is about 14.32ns making about 1,144 patterns before the cycle repeats.

Anomalies-

This lab was rather straightforward as far as figuring out the o-scope and reading the outputs. I had no errors that I found other than a typo in my code with a variable. I was a little lost with figuring out how to connect the digital o-scope cables at first to the breadboard, along with the vcc and ground but I eventually figured out where they were. At first, I didn't even realize we were to use the breadboard. I think a picture of the breadboard will save some people some time if they can't initially find their ground and VCC. Other than that, I didn't have any bugs.