Lab 3: Introduction to Digital Circuits

ECE218-L01

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Lab Date: 15 Feb 21

Due Date: 22 Feb 21

Introduction

Purpose

Measure glitches caused by delay circuit and learnt the transfer characteristics of inverter.

Scope

Measure the signal delay caused by a circuit composed of three NOT and a NAND gate.

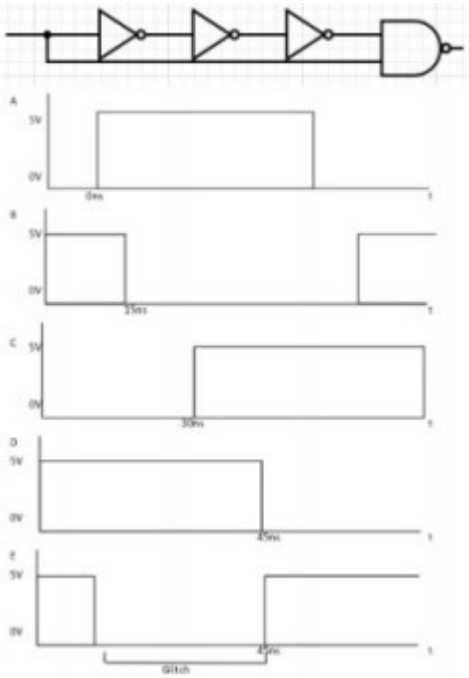
Theory

Theoretical Basis

All circuits perform basic calculations using Boolean algebra, the complexity of circuits can be created using inverters, with a slight delay between a gate receiving an input and giving an output caused by the computations of the gate. This delay is generally called the “glitch” which becomes apparent when more than 1 gate is used in series.

Preliminary Work

1. To prepare for this lab a diagram of a possible circuit was created as shown below as well as a graph that visualized what the glitch should look like

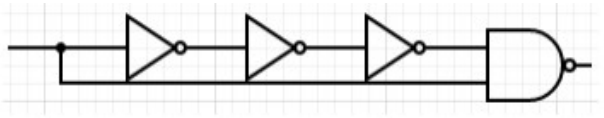


2. A truth table was also created to predict the output of a majority circuit, but the majority circuit was not created, the table was

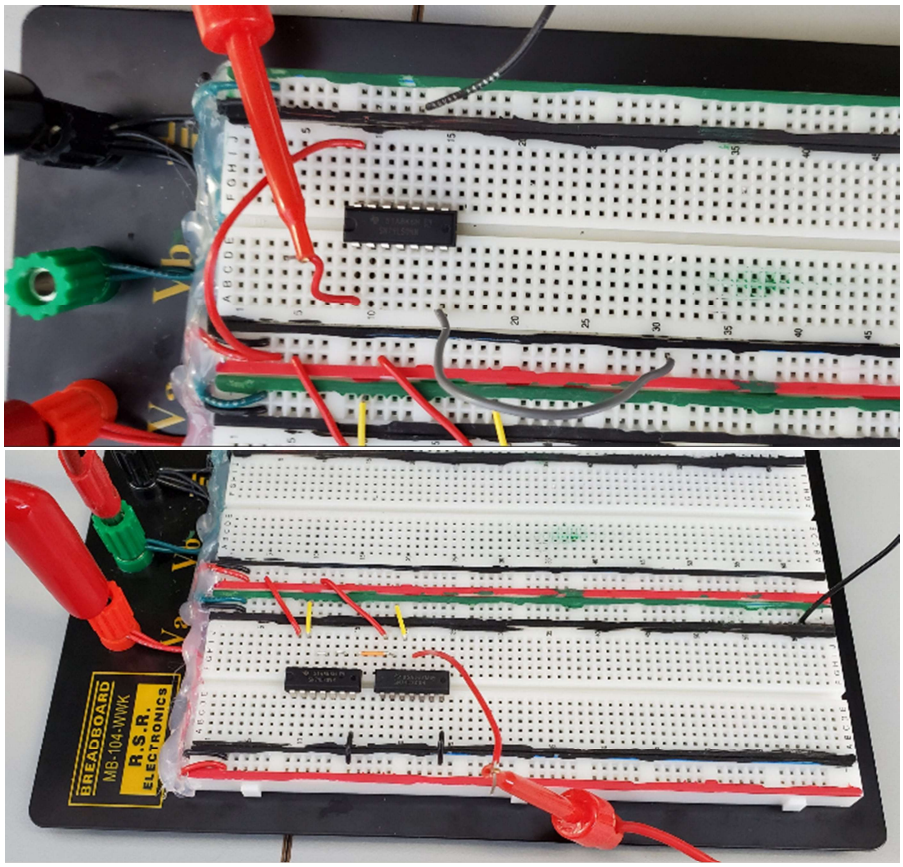
A	B	C	(AB)'	(BC)'	(AC)'	Output	Red	Green
LOW	LOW	LOW	HIGH	HIGH	HIGH	LOW	LIT	OFF
LOW	LOW	HIGH	HIGH	HIGH	HIGH	LOW	LIT	OFF
LOW	HIGH	LOW	HIGH	HIGH	HIGH	LOW	LIT	OFF
LOW	HIGH	HIGH	HIGH	LOW	HIGH	HIGH	OFF	LIT
HIGH	LOW	LOW	HIGH	HIGH	HIGH	LOW	LIT	OFF
HIGH	LOW	HIGH	HIGH	HIGH	LOW	HIGH	OFF	LIT
HIGH	HIGH	LOW	LOW	HIGH	HIGH	HIGH	OFF	LIT
HIGH	HIGH	HIGH	LOW	LOW	LOW	HIGH	OFF	LIT

Experimental Procedure

Schematics (Circuit Diagram)



Breadboard



Equipment

- copper wire
- SN74LS00N NAND gate
- SN74LS04N NOT inverter gate
- Waveform generator
- Oscilloscope

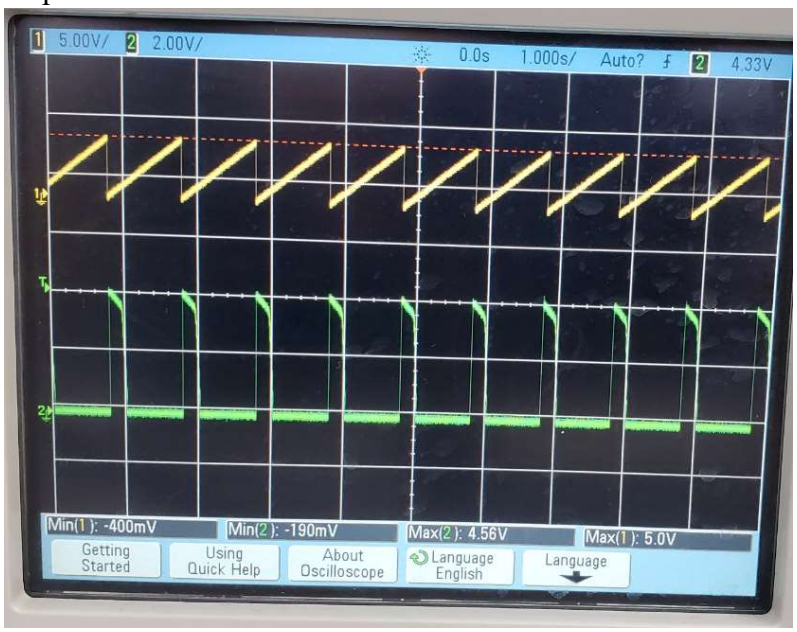
Procedure

1. Set up circuit depicted in circuit diagram on breadboard.
2. Connect breadboard to desktop voltage source and set to 5V.
3. Connect waveform generator to breadboard and oscilloscope.
4. Connect input of inverter to waveform generator with a ramp wave of 1 Hz and connect output of one inverter to oscilloscope.
5. Capture reading on oscilloscope.
6. Change waveform generator to a 1 KHz, +5 V to 0 V, 20% duty cycle pulse wave and connect output of the three inverters to oscilloscope then repeat step 5.

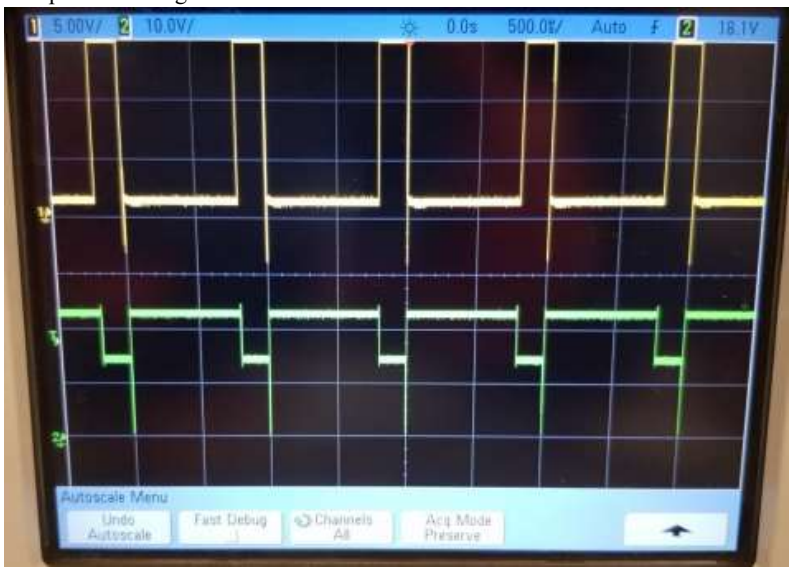
7. Add the NAND gate to the circuit used in step 5 with inputs from the three inverters and the waveform generator with the output connected to the oscilloscope then repeat step 5.\

Result

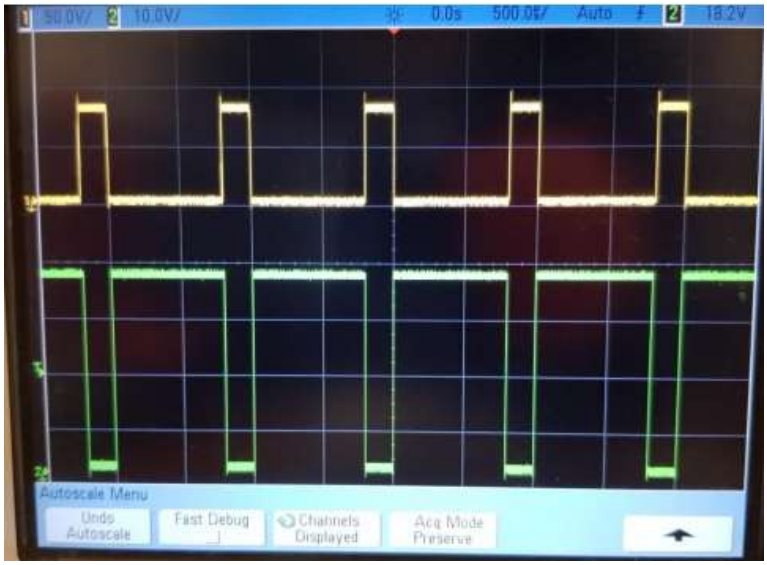
For all graphs, the wave labeled ‘1’ is from the waveform generator and the wave labeled ‘2’ is the output from the breadboard circuit.



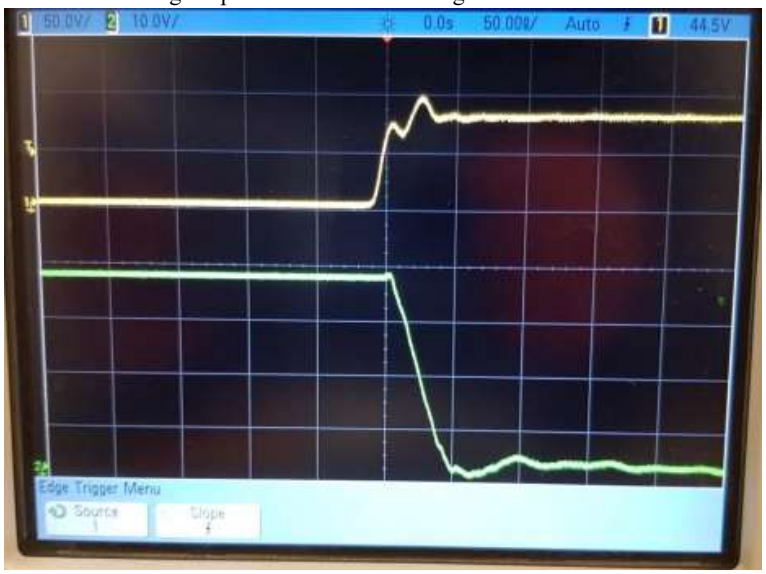
Ramp wave through inverter.



Pulse wave through triple inverter.



Pulse wave through triple inverter and NAND gate.



Glitch from triple inverter and NAND gate.

No calculations performed.

Interpretation

The results were as expected with the output of the inverter being the opposite of the input from the waveform generator. We can also see the glitch caused by the chained inverters. Using the oscilloscope, we can see that the glitch is about a 25-nanosecond delay.

Conclusion

We can conclude that inverter and NAND gates function as intended and we will be able to use it to create more complex circuits. There is an existence of delay in the output of our circuit due to the computation in the logic gates.