# Experiment #1

ECE 385

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## Introduction

This lab demonstrates the effects of delay, namely in causing glitches. We also discover that using more circuits, we can avoid these glitches effectively.

## Descriptions of the Operation of Circuits

### Part A

Figure 16 in the General Guide is a single chip implementation of the K-map from figure 12 using one 7400 Quad 2 input NAND transistor. Noteworthy is the ability to compact the circuit from figure 12 which has 3 different components to only 1 component in figure 16. It does this using De Morgan’s laws, specifically by replacing the OR gate with inverters and a NOR, then replacing those components with a NAND. Finally, the implementation gets rid of the inverter and replaces it with a NAND gate, which does the same thing.

### Part B

In Part B, the implementation gets rid of the glitch in part A. It does this by adding an AC redundancy. It then uses De Morgan’s laws to simplify the circuit. Adding this redundancy gets rid of the glitch because when the circuit in part A would output the 0, this other AC gate corrects the error making the output a 1.

## Component Layout Sheet

Chart

Description automatically generated

## Circuit Diagrams

Diagram, schematic

Description automatically generated

## Documentation from all Parts of the Lab

### Truth Table for the circuit of Pre-lab Part A

|  |  |  |
| --- | --- | --- |
| A | BC | Z |
| 0 | 00 | 0 |
| 0 | 10 | 1 |
| 0 | 10 | 0 |
| 0 | 11 | 0 |
| 1 | 00 | 0 |
| 1 | 01 | 1 |
| 1 | 10 | 1 |
| 1 | 11 | 1 |

### Pre-lab Questions

A 1) Not all groups may observe a hazard. This is because the delay for a 7400 is somewhere between 0 ns and 20 ns. If the delay happens to be 0, then there could be no delay.

A 2.) A hazard could in fact happen if you chain enough inverters, because eventually there would be a buildup of a delay that would cause a glitch to show.

### Truth Table for the circuit of Pre-lab Part B

|  |  |  |
| --- | --- | --- |
| A | BC | Z |
| 0 | 00 | 0 |
| 0 | 10 | 1 |
| 0 | 10 | 0 |
| 0 | 11 | 0 |
| 1 | 00 | 0 |
| 1 | 01 | 1 |
| 1 | 10 | 1 |
| 1 | 11 | 1 |

### Oscilloscope Printout from Lab Part 2

A screenshot of a computer

Description automatically generated with medium confidence

### Oscilloscope Printout from Lab Part 3

Graphical user interface

Description automatically generated

## Timing Diagram

Diagram

Description automatically generated

## Post Lab

1. It takes Z 60 ns until it stabilizes from the falling edge of B and 40 ns on the rising edge of B. The reason for the difference is that while from 0 to 60 ns, there could be both a 1 and a 1 inputted into Z, at 120 ns, the input (AB)’ stabilizes at 0, causing the Z output to stabilize at 0 at 140 ns no matter the value of the unstable (B’C)’. There is a glitch that could occur somewhere in these time periods, due to the uncertainty of the signals during those times.
2. The debouncer works because while the switch bounces on A, the value of B forces the output of Q immediately. In fact, the value of A has no effect on the output Q when B is stabilized. The opposite is true. While the switch bounces on B, the value of A forces the output of Q immediately.

## Answers to Questions from the General Guide

### What is the advantage of a larger noise immunity?

The advantage of having a large noise immunity is that there would be less potential for glitches and otherwise incorrect momentary data transfer. With a greater noise capacity, there is less chance for a bit to be incorrectly read which would provide a more secure signal output.

### Why is the last inverter observed rather than simply the first?

The last inverter would be observed because that inverter takes into account all the other components of the circuit. If one were to simply look at the first inverter, they would not know if there were to be incorrect data caused by noise built up through the circuit.

### Why is it bad to share resistors?

When you share one resistor among many LEDs, you link the LEDs in parallel. When multiple LEDs are linked in parallel the current running through each one increases the more LEDs you add. This can be dangerous because if too much current runs through an LED then it may burn out.

## Conclusion

In this lab the professor did the experiment in the video, so we didn’t have any actual building circuitry to do. Instead, this was a lab to understand conceptually. I had a small problem with the question about noise, due to a misconception. I cleared this up during TA office hours and corrected my misunderstanding to answer the question correctly.

