Digital Logic Design Lab #2

Objectives

Apply understanding of logic gates, system diagram, truth table schematics and logic circuit design process to design, implement and test digital logic circuits.

Preparation

Complete the following steps before starting to work on the experiments in this lab:

1) Complete lecture and assignment in Binary Number and Algebra Chapters
2) Complete Lab 1 and associated report
3) Watch the following Introductory Videos it Lab 1 is completed more than 1 week ago:
   a) Introduction to TinkerCAD Electronics at "https://youtu.be/38ur1kyFYxc"
   b) Introduction to TinkerCAD Digital Logic at "https://youtu.be/LHfqgct69bs"
   c) TinkerCAD Oscilloscope & Function Generator at "https://youtu.be/wfvYz1L0Qkk"
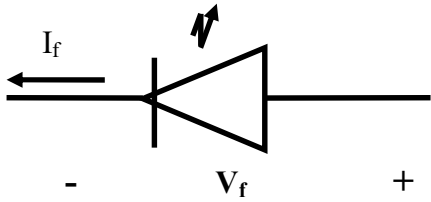
Experiment #1. LED Usage

Light Emitting Diodes (LEDs) are used as indicators in many applications from power on/off lights to traffic signal lights. LED lumination, current and power specifications vary depending on design and application. Lumex SSL-LX5093LXX is a LEDs is a common LED used and is similar to model used in TinkerCAD.

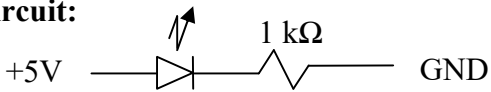*Note: LED's V_f must be positive and over 2 volts before the $I_f > 0$ Causing LED to turns on.*

Physical Diagram

Functional Diagram

Rating: $I_f < 30$ mA at 2.5 Volts
Typical: +2.1 V at I= 5 ma

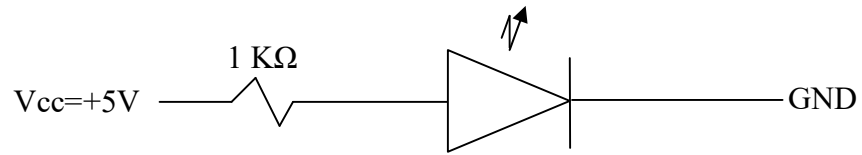**Typical Circuit:**

+5V ———▷|——— 1 kΩ ———— GND

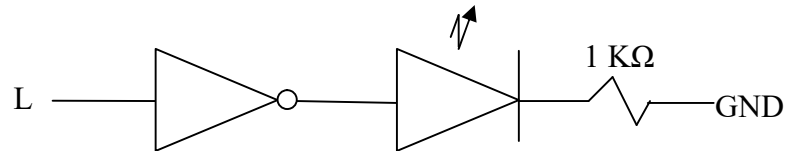Set up the following three configurations and record your observations. Explain the reason LED behavior (On or Off).

Notes:
- *"H" and True refers to logic "1" which is equivalent to connecting with 1kΩ to Vcc and +5v.*
- *"L" and False refers to logic "0" which is equivalent to connecting to GND or 0v.*

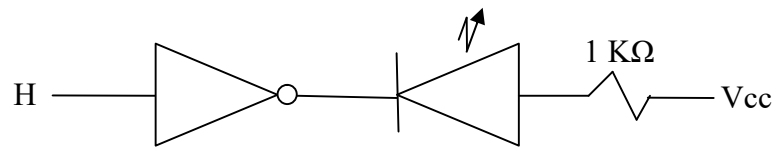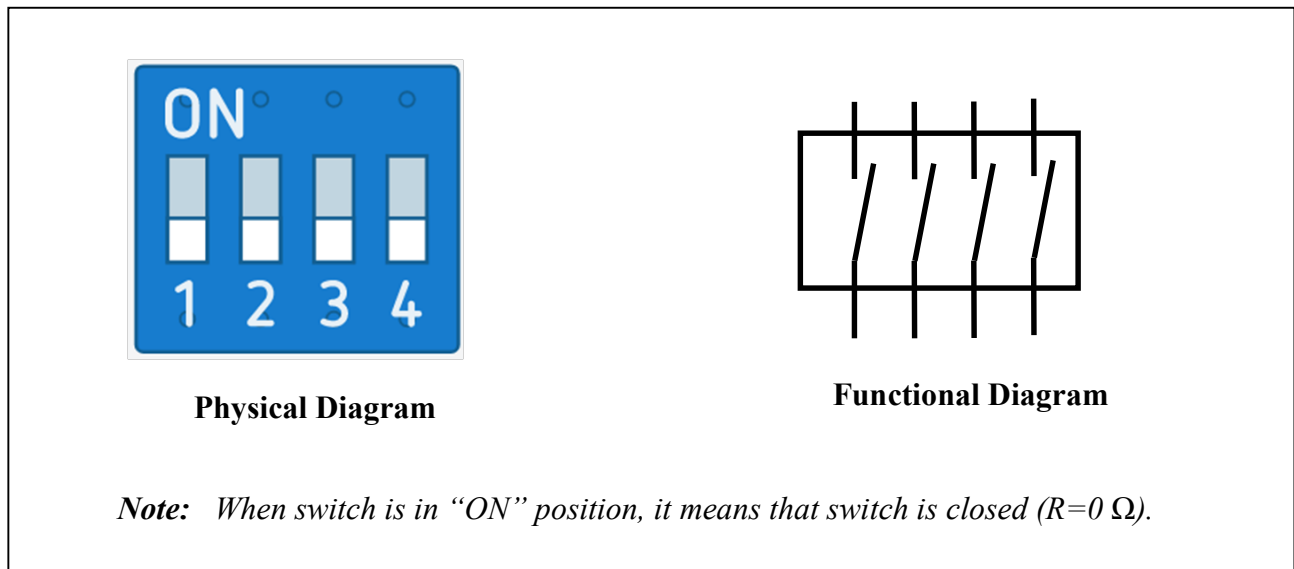**Configuration #1:**

**Configuration #2:**

Configuration #3:

Experiment #2. Switch Usage

A typical dual-in-line 4-Switch Package contains 4 independent switches as shown below:

Physical Diagram   **Functional Diagram**

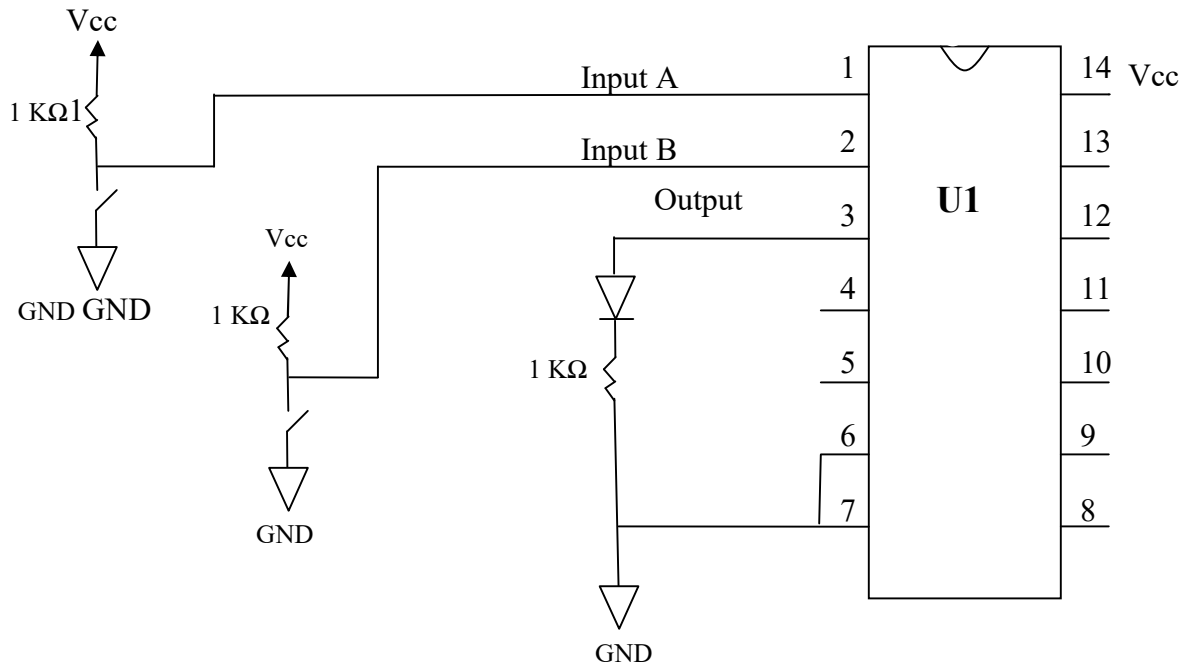*Note:* *When switch is in "ON" position, it means that switch is closed (R=0 Ω).*

Set up the following circuit and complete the truth table relating the switch setting and status of LEDs. Use the assigned "1" and "0" values for switch setting and LED status in the truth table.
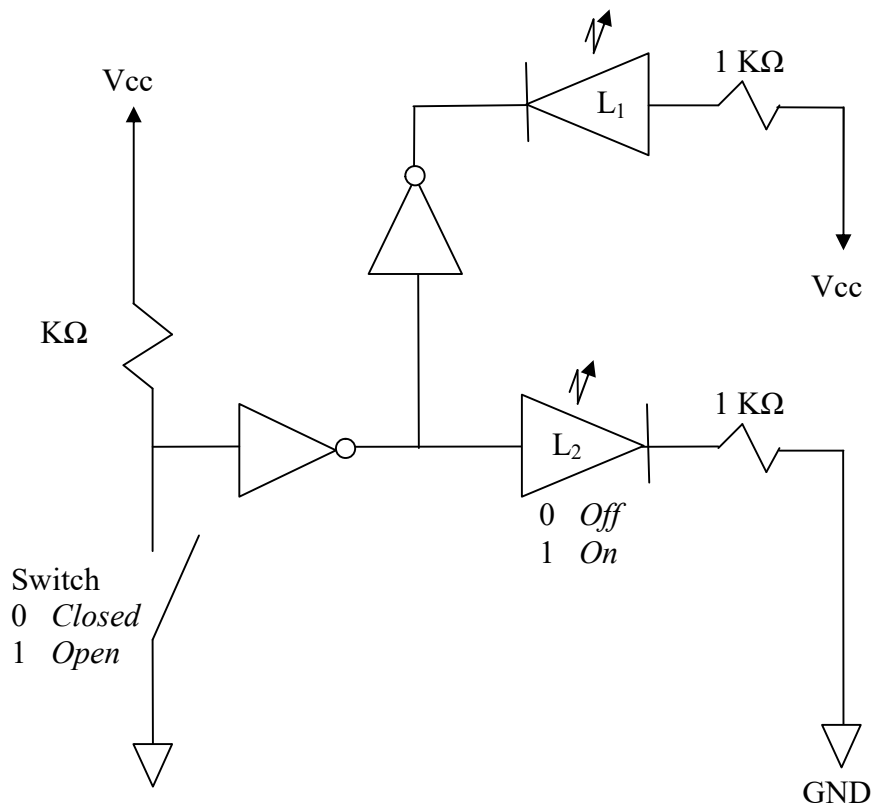
Experiment 3. 74HC08

Use "74HC08" as U1 and build the circuit shown below in TinkerCAD:

Use the TinkerCAD to implement the above circuit and create a truth table by setting switches to all their possible position. Confirm that the performance is consistent with 74HC08.

Experiment 4. 74HC032
Use "74HC32" as U2 and build the circuit shown below in TinkerCAD:

Use the TinkerCAD to implement the above circuit and create a truth table by setting switches to all their possible position. Confirm that the performance is consistent with 74HC32.
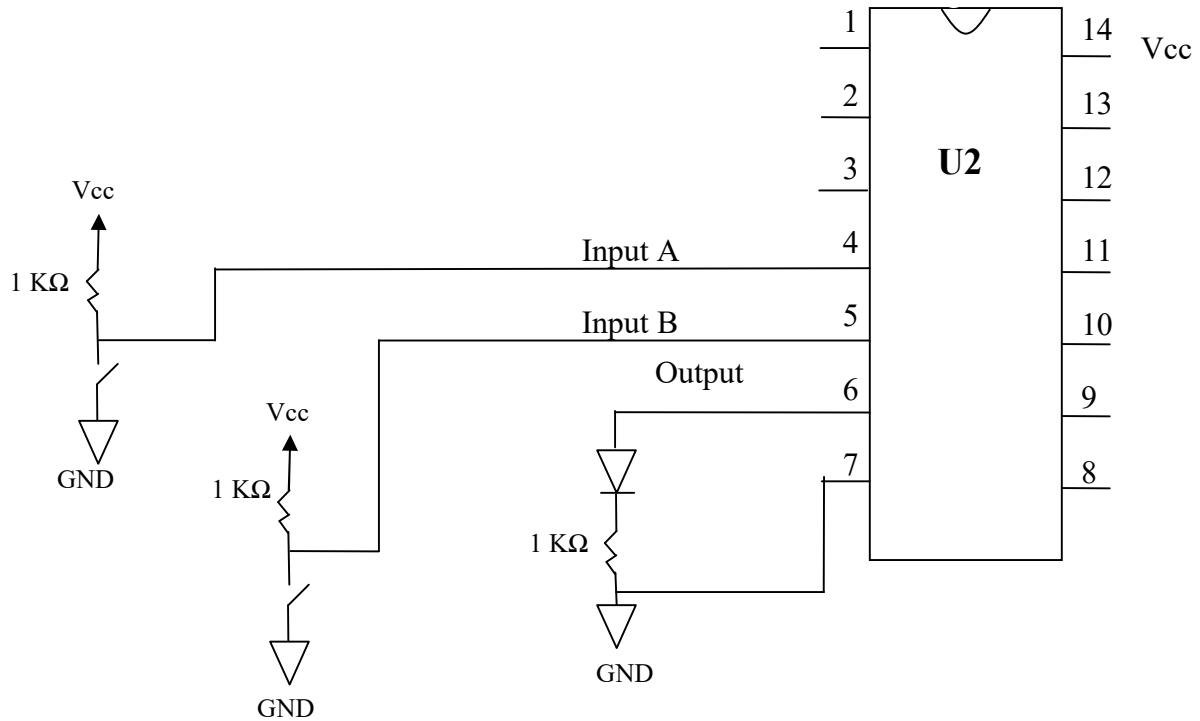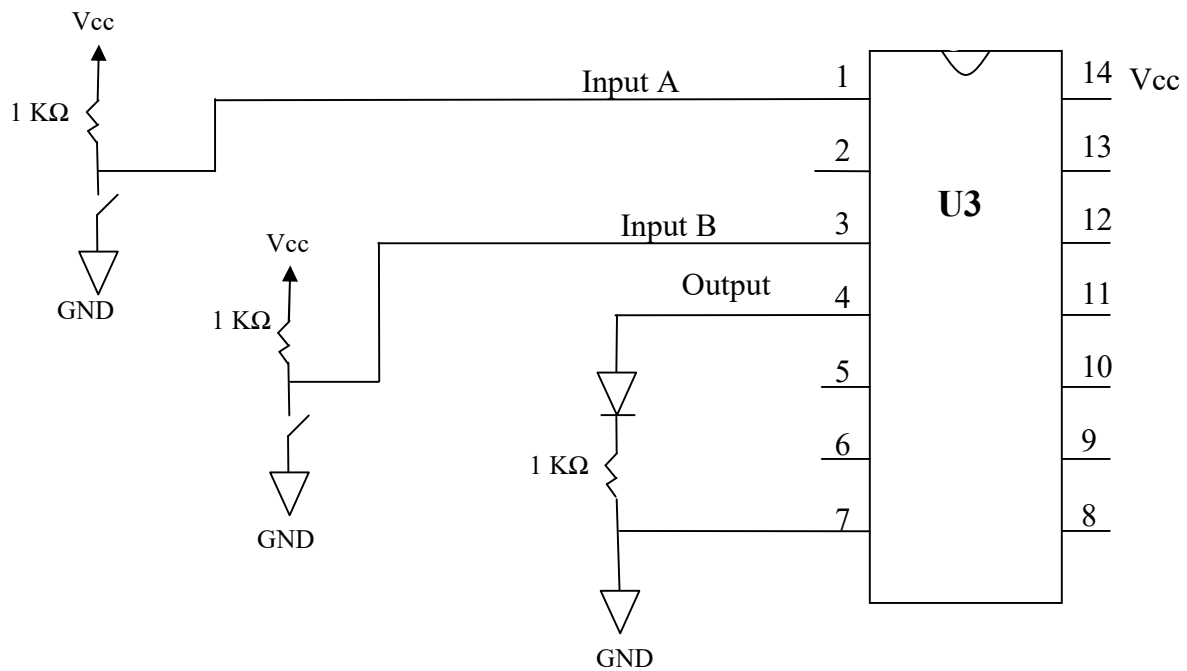
Experiment 5. 74HC04

Use "74HC04" as U3 and build the circuit shown below in TinkerCAD:

Use the TinkerCAD to implement the above circuit and create a truth table by setting switches to all their possible position. Confirm that the performance is consistent with 74HC04.

Experiment 6. Traffic Control Signal System Design

A three way intersection is need of a traffic signal control system and you have been assigned the task to design (Do not implement) the system. Each direction has only one lane and one signal control light (green and red) per Lane. Further, you have been asked to give only one lane go or green sign at a time.

Complete the following steps:

1) Sketch of the intersection and define the input/out variables and values
2) Draw the system diagram showing the input and output
3) Generate a Truth Table for the system
4) Draw the schematic for your design using only 74HCxx available in TinkerCAD

Report Requirements

This lab and associated report must be completed individually. All reports must be computer printed (formulas and diagrams may be hand drawn) and at minimum:

For each experiment include:
- Clear problem statement; specify items given and to be found.
- Answer experiment questions
- Resulting circuit schematics, simulation results, and other relevant information from the experiment.

For the whole report include:
- A Cover sheet with your name, class, lab and completion date.
- A Lessons Learned section which summarizes your learning from this lab.
- A New Experiment section that has description of a new experiment and the experiment's results. Experiment should be related to material covered in class but not similar to one of the experiments in this lab.