

Title: Introduction to Primary and Universal Logic Gates

Objectives

The objectives of this experiment are:

- To verify the input and output relationships/characteristics of 2-input AND, OR, and 1-input NOT gates.
- To gain familiarity with integrated circuits (ICs) and their pin configurations.
- To understand the practical implementation of basic logic gates using a breadboard and laboratory equipment.

Introduction

Logic gates are the fundamental components of digital circuits, performing basic logical operations on binary inputs to produce binary outputs. The AND gate outputs a logic 1 only when all inputs are 1, the OR gate outputs a logic 1 when at least one input is 1, and the NOT gate inverts its input. This experiment aims to verify the truth tables of these gates using specific ICs: 7408 for AND, 7432 for OR, and 7404 for NOT. The setup involves the AT-700 Portable Analog/Digital Laboratory, a breadboard, data switches for inputs, and an LED light to observe outputs. By testing all possible input combinations, this experiment confirms the theoretical behavior of these gates and provides hands-on experience with digital electronics hardware.

Procedures

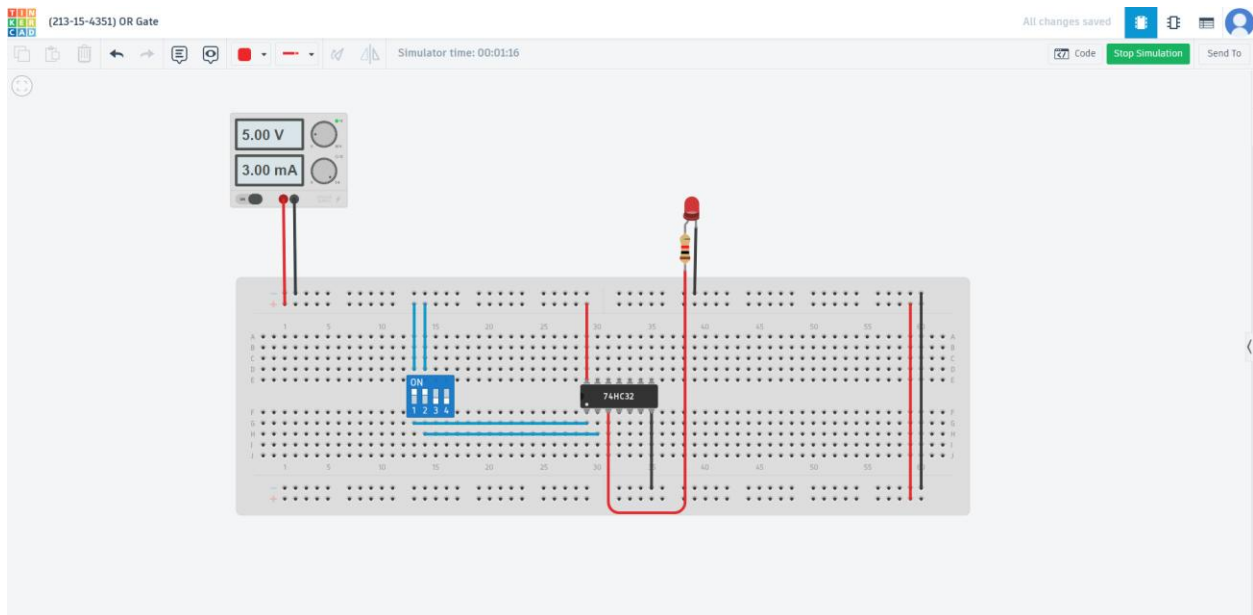
The experiment was conducted following these steps from the lab manual:

1. **Identify Pin Configurations:** Determined the correct input and output pin numbers for the 7408 (AND), 7432 (OR), and 7404 (NOT) ICs using their datasheets.
2. **Setup Circuit on Breadboard:** Installed the components as shown in the circuit diagram (Fig. 1-1) on the AT-700 breadboard. Connected pin 14 of each IC to +5V and pin 7 to GND on the AT-700 power supply.

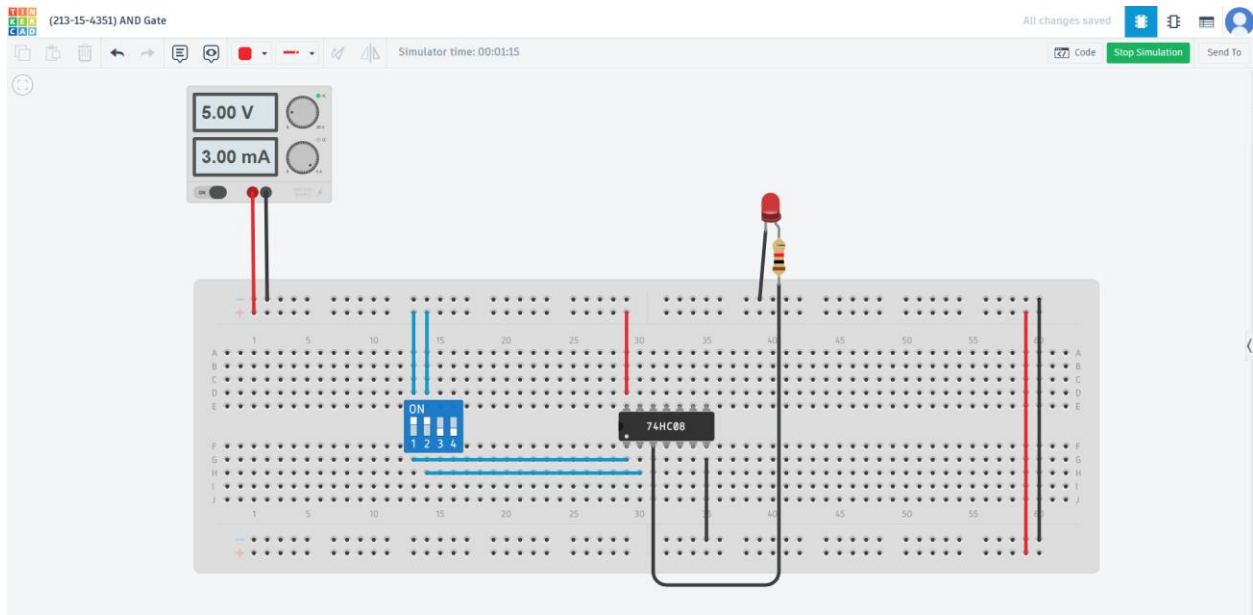
3. **Connect Inputs and Outputs:** Connected data switches "0" and "1" to points A and B of the circuit, respectively. Connected the LED light's pins "0", "1", and "2" to the output points Y1 (AND), Y2 (OR), and Y3 (NOT) of the circuit.
4. **Test Input Combinations:** Changed the data switches "0" and "1" between logic 0 and 1 positions to apply all possible input combinations (00, 01, 10, 11) for the AND and OR gates, and 0 and 1 for the NOT gate. Observed the LED light, where a lit LED indicated logic 1 and a dark LED indicated logic 0.
5. **Record Results:** Recorded the observed outputs in a truth table for each gate.

Experiment Pictures

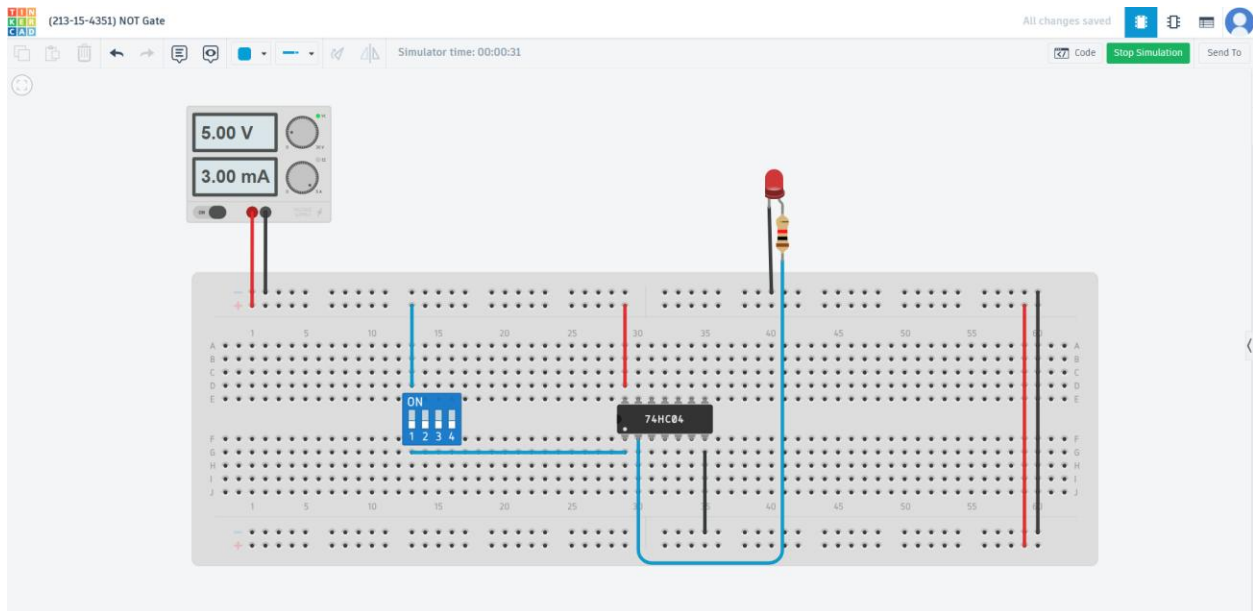
OR GATE (7432):



AND GATE (7408):



NOT GATE (7404):



Tinkercad Link

OR GATE: https://www.tinkercad.com/things/kW4hIDgljEi-213-15-4351-or-gate?sharecode=4cH3ZgP_uRT-ep_GVSZ4ZCIBar3P4qM7-PsBcmABJ6c

AND GATE: https://www.tinkercad.com/things/dPq4cLuK09q-213-15-4351-and-gate?sharecode=k8gFQDStaCl_XKx2WY0wrmOD0WsVWCs93Lt_Z_Ni3e4

NOT GATE: https://www.tinkercad.com/things/d4SpR1BU6t7-213-15-4351-not-gate?sharecode=xa7dJ-d_AeizJ4OPsGFIJOX3YRULVIEZrGHNJ49vVdM

Experimental Results

The experiment tested all possible input combinations for the AND, OR, and NOT gates, with outputs observed on the LED light. The results are summarized in the following tables:

AND Gate (7408)

A	B	Y1 (AND)
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate (7432)

A	B	Y2 (OR)
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate (7404)

A	Y3 (NOT)
0	1
1	0

The LED light showed a lit LED for logic 1 and a dark LED for logic 0, matching the expected outputs for each gate based on their theoretical behavior.

Conclusion

This experiment successfully verified the input-output relationships of the 2-input AND, OR, and 1-input NOT gates using the 7408, 7432, and 7404 ICs, respectively. The observed results in the truth tables matched the expected behavior: the AND gate outputs 1 only when both inputs are 1, the OR gate outputs 1 when at least one input is 1, and the NOT gate inverts its input. The practical setup on the AT-700 breadboard provided valuable experience in working with IC pin configurations, breadboard wiring, and digital circuit testing. This experiment established a solid foundation for understanding and implementing basic logic gates in digital electronics.