Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
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Electro technology Lab Report

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LAB SESSION: *SESSION 2 (4 – 6PM)*

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MODULE: *CS 1025*

OBJECTIVE

To build a NAND gate and a NOT gate using two N-MOSFET transistors.

INTRODUCTION

The aim of this experiment is to build a NAND and NOT gate using two N-MOS FET transistors. The output of a NAND gate is 0 when both inputs of the transistors are 1 otherwise the output is 1. The output is displayed by the resistor. When the output is 1 the LED lights up and when the output is 0 the LED doesn't light up.

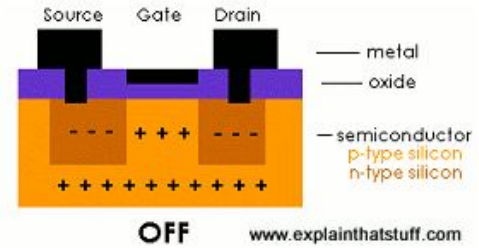
APPARATUS

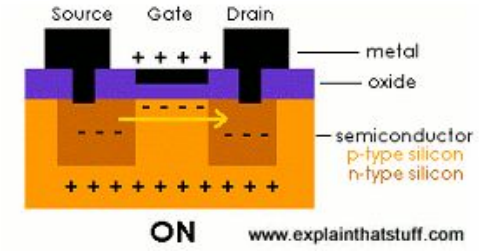
1. 1KΩ resistor
2. A.C current source
3. Breadboard
4. LED
5. 2N7000 E-MOSFET transistor (2x)
6. 5KΩ resistor

BACKGROUND INFORMATION

TRANSISTOR

It can work either as an amplifier or a switch but for the purpose of this experiment it will act as a switch.
Transistors work by controlling the movement of electrons. A FET (field effect transistor) has three different terminals--- source, drain, and gate. In a FET, the layers of n-type and p-type silicon are arranged in a slightly different way and coated with layers of metal and oxide. That gives us a device called a MOSFET (Metal Oxide Semiconductor Field Effect Transistor).

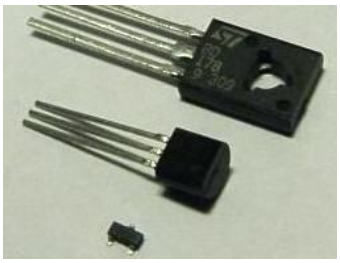


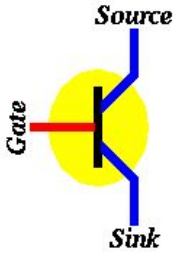


If we attach a positive voltage to the gate, an electric field is created that allows electrons to flow in a thin channel from the source to the drain. This "field effect" allows a current to flow and switches the transistor on.

When the gate of a transistor is ON (or has a value 1) then electricity flows from the source to the drain and the transistor is said to be ON

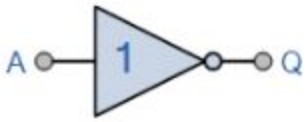
Otherwise when the gate of a transistor is OFF (or has a value 0) then electricity does not flow from the source to the drain and the transistor is said to be OFF.





NOT GATE

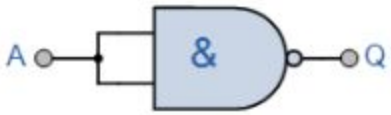
It is a single input device which goes “LOW” to a logic level “0” when its single input is at logic level “1”, in other words it “inverts” its input signal. The output from a NOT gate only returns “HIGH” again when its input is at logic level “0”.



Inverter or NOT Gate

NAND GATE

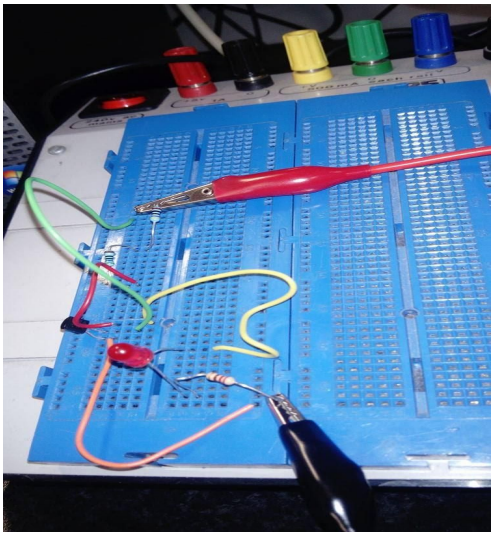
The NAND gate has an output that is normally at logic level "1" and only goes "LOW" to logic level "0" when all of its inputs are at logic level "1". The NAND Gate is the reverse form of the AND gate



2-input NAND Gate

METHOD

Circuit 1



1. Assemble the circuit as shown in the diagram
2. Connect the gate of the transistor to ground and observe
3. Then connect the gate of the transistor to power and observe the result
4. Write up the truth table for this gate and identify it

RESULT/OBSERVATION

- When we connected the gate of the transistor to ground we were applying an input of 1 and getting an output of zero as a result the LED did not light up

- When we connected the gate of the transistor to power we were applying an input of 0 and getting an output of 1 and as are result the LED lit up.

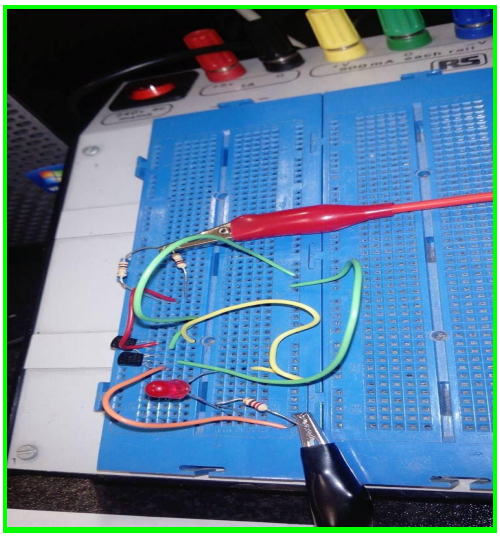
By noting these results and drawing up the truth table we can identify this gate as a NOT gate.

NOT GATE TRUTH TABLE

INPUT	OUTPUT

0	1
1	0

CIRCIUT 2



1. Assemble the circuit as shown in the diagram
2. Connect the gate of transistor A to ground and gate of transistor B to power and observe
3. Then connect the gates of both transistors to power and observe the result
4. Connect the gate of transistor B to ground and the gate of transistor A to power and observe
5. Then connect the gates of both transistors to ground and observe the result

RESULT/OBSERVATION

- When we connected transistor A to ground and gate of transistor B to power, A had an input of 0 and B had an input of 1, as a result we got an output of 1 which resulted in the LED lighting up

- When we connected the gates of both transistors to power, A had an input of 1 and B had an input of 1, as a result we got an output of 0 which resulted in the LED not lighting up

- When we connected the gate of transistor B to ground and the gate of transistor A to power, A had an input of 1 and B had an input of 0, as a result we got an output of 1 which resulted in the LED lighting up

- When we connected the gates of both transistors to ground, A had an input of 0 and B had an input of 0, as a result we got an output of 1 which resulted in the LED lighting up

When at least one of the transistor gates are connected to ground it forms an open circuit.
By noting these results and drawing up the truth table we can identify this gate as a NAND gate.

NAND GATE TRUTH TABLE

A	B	OUTPUT
0	0	1
0	1	1
1	0	1
1	1	0

EXTRA NOTES

When we use a 5kΩ resistor in this experiment instead of a 1k resistor the LED light is much dimmer.

Input/Output Voltage Tables

TRANSISTOR GATE AT GROUND (1KΩ AND 5KΩ RESISTOR)

INPUT	OUTPUT VOLTAGE
5V	2.13V (1kΩ resistor)
	2.84v (drain source voltage)
	2.39v (LED)
	0.44V (220Ω resistor)

TRANSISTOR GATE AT LOGIC 1 (1K RESISTOR)

INPUT	OUTPUT VOLTAGE
5V	4.97V (1kΩ resistor)
	0.01v (drain source voltage)
	2.39v (LED + 220kΩ resistor)

BOTH TRANSISTOR GATEs AT GROUND (5KΩ RESISTOR)

INPUT	OUTPUT VOLTAGE
5V	2.89V (1kΩ resistor)
	2.1v (drain source voltage)
	1.97v (LED)
	0.12V (220Ω resistor)

CONCLUSION

We can build a NOT and NAND gate and plot there truth tables using MOSFET transistors as our switches.

SOURCES

Grob's Basic Electronics 11th Edition

http://www.dummies.com/programming/electronics/diy-projects/electronics-projects-how-to-create-a-transistor-not-gate-circuit/

http://www.electronics-tutorials.ws/logic/logic_4.html

http://www.electronics-tutorials.ws/logic/logic_10.html

http://www.explainthatstuff.com/howtransistorswork.html