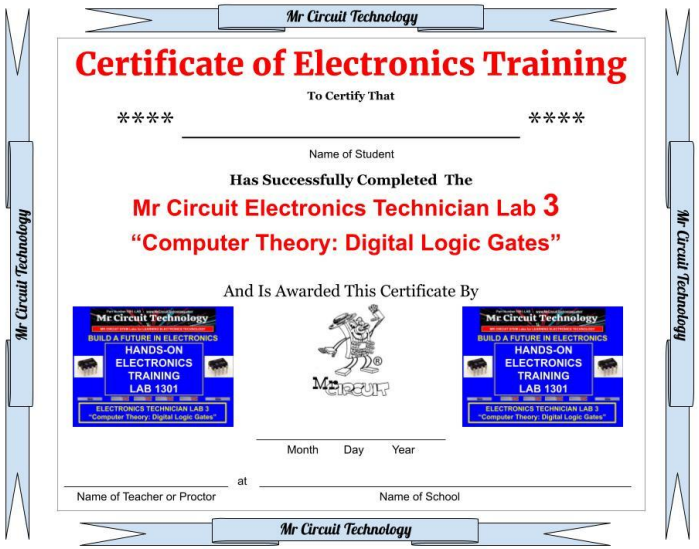
COVER

This is the *FIRST* lesson in the

MR CIRCUIT LAB 3.



COMPLETE THIS LAB 3 AND EARN A CERTIFICATE OF ELECTRONICS TRAINING

LAB 3: Computer Theory: Digital Logic Gates

01 00 COVER 1301-SL1

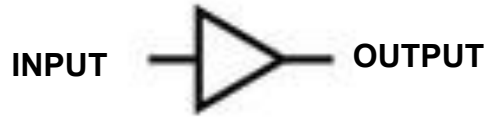
Basic Electronics

LAB 3

Digital Logic Gates for future Engineers and Techs

Lesson 1

The 'YES' Logic Gate



There are 5 pages. Start with Page 1 at the center of this booklet.

Booklet Number 1301-SL1

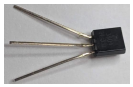
Introduction to Digital Logic Gates "The 'YES' Logic Gate"

Welcome to the world of Electronics, Computers, Robotics, and Drones. This Electronics Technician Lab 3 is part of the Mr Circuit series of labs covering the electronics technology used in **today's modern digital devices.**

We start this series with **Digital Logic Gates** because they are the **'building-blocks'** of all digital circuits and they do all the **logical functions,** (the making of decisions)**,** that are fundamental to digital circuits which are used in computers, smartphones, robots, tablets and other digital control devices.

You have probably heard that computers "think" and make decisions . In fact, **THINK** was the slogan for the largest computer company in the world, **IBM** (International Business Machines) .

Tubes



Transistors

IC's

In the beginning of electronics, electric logic gates were built out of electromechanical switches, sometimes referred to as relays. The first computers had lots of these relays. As the field of electronics progressed, they were able to use vacuum tubes in place of relays. And, with the discovery of transistors, they replaced the vacuum tubes. Then, with advances in optics, they were able to miniaturize logic circuits to make computers that could be on the desk (desktop), then in your lap (laptop), and then in your hand (hand-held).

LAB 3: Computer Theory: Digital Logic Gates

Computer circuits make decisions using the logic gate circuits. There are 8 logic gate circuits. They are given the following names: **YES, NOT, AND, NAND, OR, NOR, XOR, and XNOR**. All logical decisions can be made using these Logic Gates.

There are 8 lessons in this lab, one for each Logic Gate. In each lesson, we will define the Logic Gate and show its Truth Table. **What is a Truth Table?** It is a chart showing the inputs and outputs of a Logic Gate. We will show these Truth Tables as we discuss the 8 Logic Gates. A **logic gate** makes a decision based on the signals coming to its input. Most logic gates have two inputs and one output.

There are only two types of input or output for a logic gate, **True or False**. Sometimes the words **HI** and **L0** are used for words True and False. Sometimes the numbers **1** and **0** are used for the words True and False.

True = HI = 1

False = LO = 0

Here is the Truth Table for the 'YES' Logic Gate. You will notice that when the input A = 0, then the output Q = 0. That is to say, for the 'YES' Logic Gate, the output equals the input.

Truth Table for a 'YES' Gate

In	Out
A	Q
0	0
1	1

PAGE 1

Introduction to Digital Logic Gates "The YES Logic Gate"

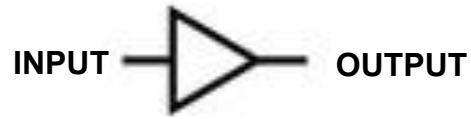
Here is a Truth Table again for a '**YES'** Logic Gate. For the 'YES' Gate, the output is the same as the input. If there is a HI on the input, there will be a HI on the output.

Since there is only one input to this logic gate, there are only 2 possible combinations on these inputs as shown in the Truth Table below. There is 0 or 1

Truth Table 'YES' Gate	
Input	Output
A	Q
0	0
1	1

You will note that when its input is 1, its output is 1, and accordingly, when its input is 0 its output is 0.

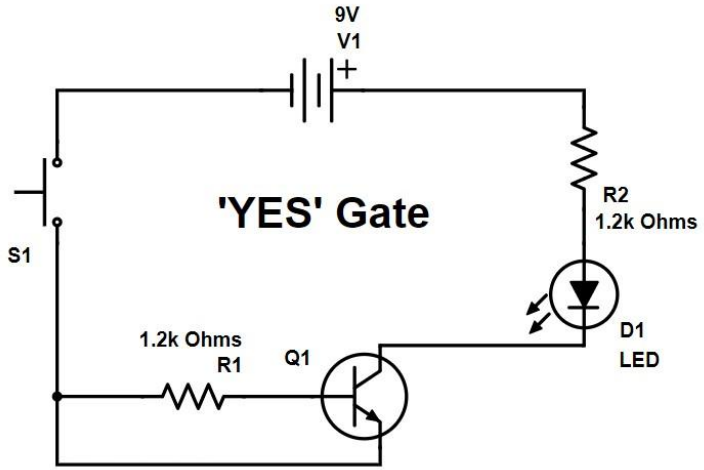
Here is the symbol of a 'YES' **Gate.**



LAB 3: Computer Theory: Digital Logic Gates

In digital electronics, a "YES Gate" is an electronic circuit that will output a digital "HI" if the input is "HI" and a "LO" if the input is "LO". We can also use a **1** for a HI and a **0** for a LO.

Here is a schematic for an electronic circuit that will work as a 'YES' Logic Gate.



Explanation of this circuit: Switch S1 controls the voltages of transistor Q1. Remember that when a transistor is **forward-biased**, it means that it has the correct voltages on its pins, and therefore, it will conduct current. In this circuit, the transistor is not **forward-biased** until you press Switch S1.

When you press S1, it puts the right voltages on Q1 so that it will conduct current. The LED will light up indicating a HI on the output

When you release Switch S1, the input to the transistor goes back to LO and the LED turns off showing a LO on the output.

Now, use the QR Code to watch video Lesson 1. Then, using Pages 4 and 5, let's build this 'YES' Logic Gate circuit on a solderless circuit board.

Step-by-Step Assembly Guide for "The YES Logic Gate"

Step 1: Follow these steps carefully to build the 'YES' Logic Gate.

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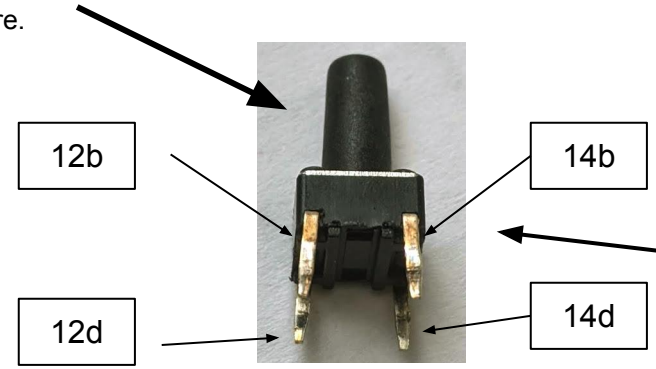
Step 2: Find the Experiment Parts Bags for the Mr Circuit Lab 3

Step 3: Take out the following parts needed to build the 'YES' Gate:

- one Solderless Circuit Board
- one 9-Volt Battery Snap
- one LED (Light Emitting Diode)
- two 1200 (1.2k) Ohm resistors (Brown, Red, Red, Gold)
- three Jumper Wires
- one NPN Transistor (3904)
- one Normally-Open Pushbutton Switch

Step 4: Now, using the Pix of the Assembled Circuit on Page 5, install all the parts on the Solderless Circuit Board in this order.

__ **Install** the NPN transistor Emitter in 19c, Base in 18c, Collector in 17c
__ **Install** the LED, Cathode in 3d, Anode in 6e
__ **Install** a 1200 Ohm resistor in 6a to the Positive Buss
__ **Install** a 1200 Ohm resistor in 14a and 18b
__ **Install** a Jumper Wire in 19e to the Negative Buss
__ **Install** a Jumper Wire in 12a to the Positive Buss
__ **Install** a Jumper Wire in 17e to 4c
__ **Install** the Battery Snap, Red in the Pos. Buss, Black in Neg. Buss
__ **Install** the Normally-Open Pushbutton with 4 legs. Install the legs as shown here.



LAB 3: Computer Theory: Digital Logic Gates

Step 5: Lightly touch the battery to the Battery Snap (Note: do not connect it, just touch it lightly.) The LED should not light up. If it does, then please check your wiring carefully and try again.

Step 6: With the battery connected, depress Switch S1. Did the LED light up? _____

Step 7: What does it indicate when the LED lights up?

_____ .

Step 8: When Switch S1 is not depressed, transistor Q1 is not

_____ .

Step 9: Conclusion: You should have observed that this circuit works like a 'YES' Logic Gate. When Switch S1 puts a HI on the Base of Q1, the transistor is forward-biased and conducts current. This causes the LED to light up indicating a _____ on the output of the 'YES' Logic Gate.

You have now learned how a 'YES' Logic Gate works and how to build one using electronic components. These are the same type of components used in today's digital circuits.

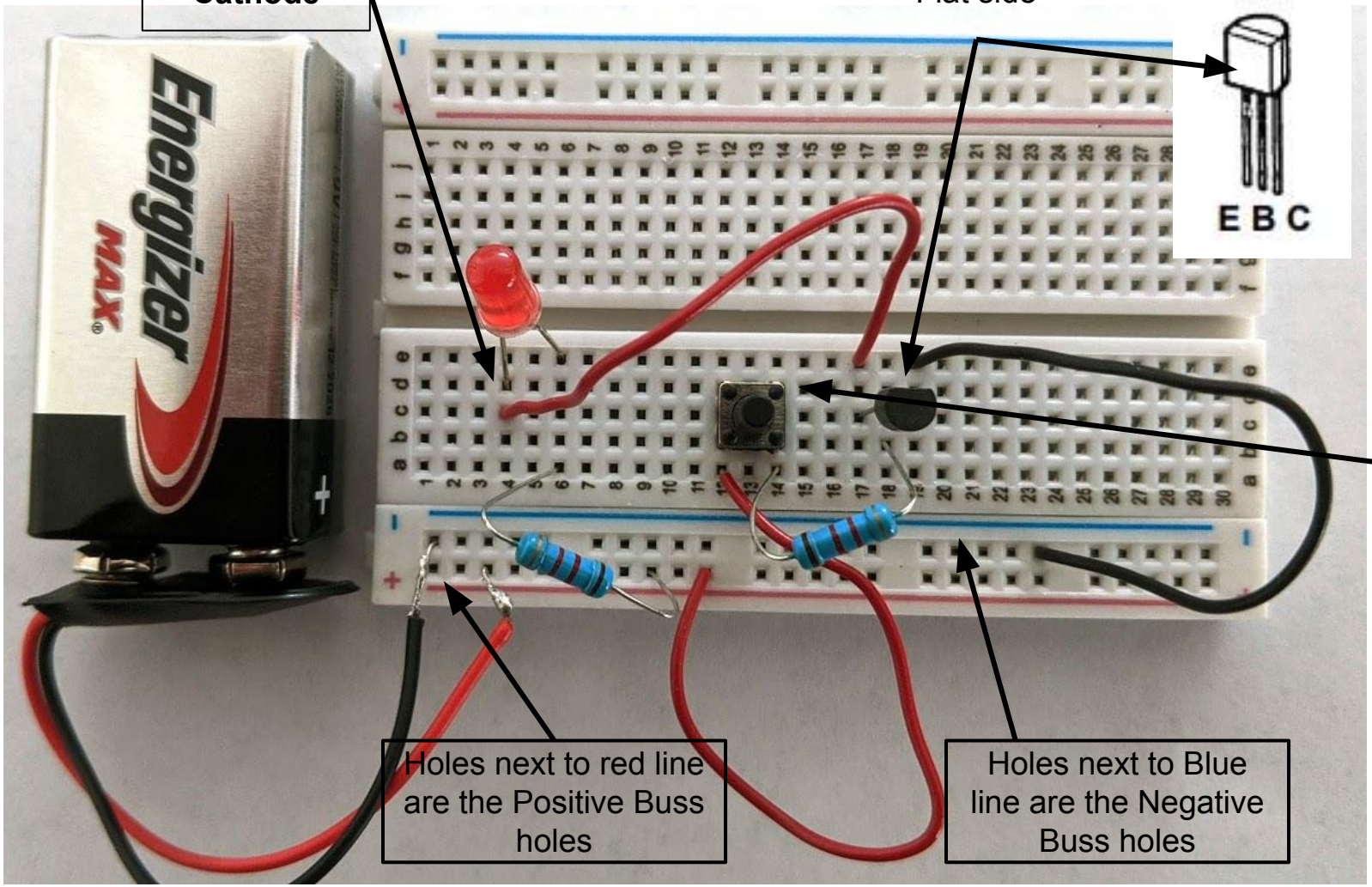
Step 10: Now, disassemble the circuit and put all the parts back into the plastic bag and go to the next lesson in this lab.

NOTE regarding the pins on the Pushbutton switch:
Legs 12b to 14b are normally-open
And
Legs 12d and 14d are also normally-open

But Legs 14d and 14b are shorted together just as Legs 12d and 12b are shorted.

PAGE 3

Assembly Pix for Lesson 1 “The YES Logic Gate”



PAGE 4

PAGE 4

Lesson 1 - The ‘YES’ Gate