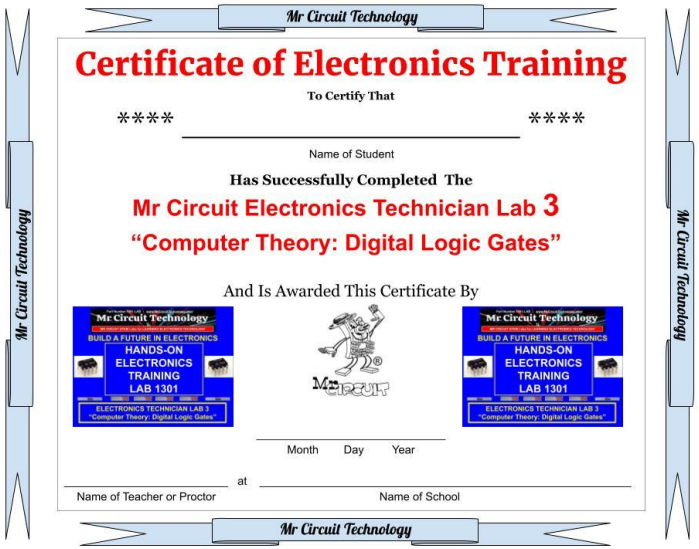
COVER

This is the *SIXTH* 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

06 00 COVER 1301-SL6

Basic Electronics
LAB 3
Digital Logic Gates for future Engineers and Techs

Lesson 6

The 'NOR' Logic Gate

INPUTS  OUTPUT

There are 3 pages. Start with Page 1 at the center of this booklet.

Booklet Number 1301-SL6

MR CIRCUIT ELECTRONICS TRAINING LAB

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Introduction to Digital Logic Gates "The 'NOR' Logic Gate"

The **'NOR' Logic Gate** has two inputs. The 'NOR' Gate is a combination of an 'OR' Gate followed by a 'NOT' Gate. It is the inverted form of an 'OR' Gate.

INPUTS  **OUTPUT**

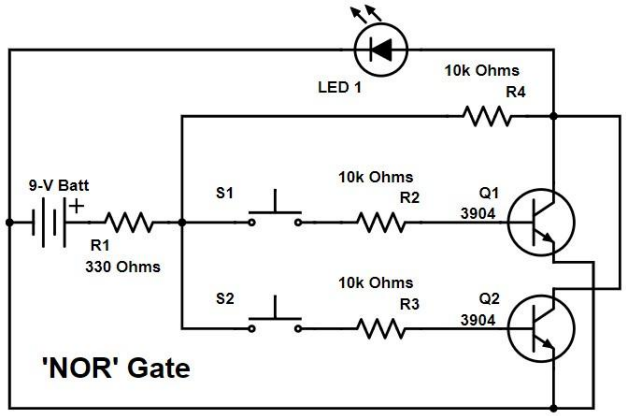
There are 4 possible combinations on these inputs as shown in the Truth Table below. The output is True if both inputs are False. Otherwise, the output is False. Here are the Truth Tables for the 'OR' Gate and the "NOR' Gate so you can compare.

Truth Table for the 'OR' Gate		
Input A	Input B	Output Q
0	0	0
0	1	1
1	0	1
1	1	1

Truth Table for the 'NOR' Gate		
Input A	Input B	Output Q
0	0	1
0	1	0
1	0	0
1	1	0

LAB 3: Computer Theory: Digital Logic Gates

Here is a schematic of an electronic circuit that performs the function of a 'NOR' Logic Gate.



Explanation of the circuit: This circuit has two transistors. If you forward-bias either one or both of them the LED will not light up indicating a LO on the output.

There are two Normally-Open pushbutton switches in this circuit. Switch S1 controls the voltages on Transistor Q1 and Switch S2 controls the voltages on Transistor Q2. If you press S1, it causes Q1 to be forward-biased and the LED will not light up. If you press S2, it will cause Q2 to be forward-biased and the LED will not light up. If you press both switches at the same time, it forward-biases both transistors and the LED will not light up.

So, as you can see, this circuit acts like an 'NOR' Logic Gate, that is, if either or both inputs are True the output will be False. Switch S1 gives a True to Transistor Q1 and Switch S2 gives a True to Transistor Q2. The circuit is wired such that there will be a LO on the output when your press either switch or both switches at the same time.

Now, use the QR Code to watch video Lesson 1. Then, using pages 2 and 3 in this booklet, build a 'NOR' Logic Gate circuit.

PAGE 1

Step-by-Step Assembly Guide for "The 'NOR' Logic Gate"

Step 1: Follow these steps carefully to build the **'NOR'** 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 **'NOR'** Logic Gate:

- one Solderless Circuit Board
- one 9-Volt Battery Snap
- one LED (Light Emitting Diode)
- one 220 Ohm resistor (Red, Red, Brown, Gold)
- one 330 Ohm resistor (Brown, Black, Red, Gold)
- two 10,000 (10k) Ohm resistors (Brown, Black, Orange, Gold)
- six Jumper Wires
- two NPN Transistors (3904)
- two Normally-Open Pushbutton Switches

Step 4: Now, using the Pix of the Assembled Circuit on Page 3, install all the parts on the Solderless Circuit Board in this order.

__ **Install** the NPN transistor Emitter in 7c, Base in 6c, Collector in 5c
__ **Install** the NPN transistor Emitter in 7h, Base in 6h, Collector in 5h
__ **Install** the LED, Anode in 5b, Cathode in 4b
__ **Install** a 220 Ohm resistor in 15e to 5d
__ **Install** a 330 Ohm resistor in 25f to 15a
__ **Install** a 10,000 Ohm resistor in 10a to 6a
__ **Install** a 10,000 Ohm resistor in 10j to 6i
__ **Install** a Jumper Wire in 15c to 12f and another in 15b to 12a
__ **Install** a Jumper Wire in 7f to 7e and another in 5f to 5e
__ **Install** a Jumper Wire in 25b to 7a and another in 25a to 4a
__ **Install** the Battery Snap, Red in 25h, Black in 25d

__ **Install** the two Normally-Open Pushbutton switches with 4 legs. Install the legs as shown here.

12d 10d
12b 10b

Switch S1

12i 10i
12g 10g

Switch S2

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

Step 6: With the battery connected, press Switch S1. Did the LED light turn off? ____

Step 7: Press Switch S2, did the LED light turn off? ____

Step 8: Now, press both switches at the same time forward-biasing both transistors. Did the LED light turn off?_____ .

Step 9: Conclusion: You should have observed that this circuit works like an **'NOR' Logic Gate.**

When Switch S1 puts a HI on the Base of Q1, the LED turns off indicating a LO on the output. And, when Switch 2 puts a HI on the Base of Q2, the LED turns off. And, when you press both switches at the same time, the transistors are both forward-biased and the LED turns off.

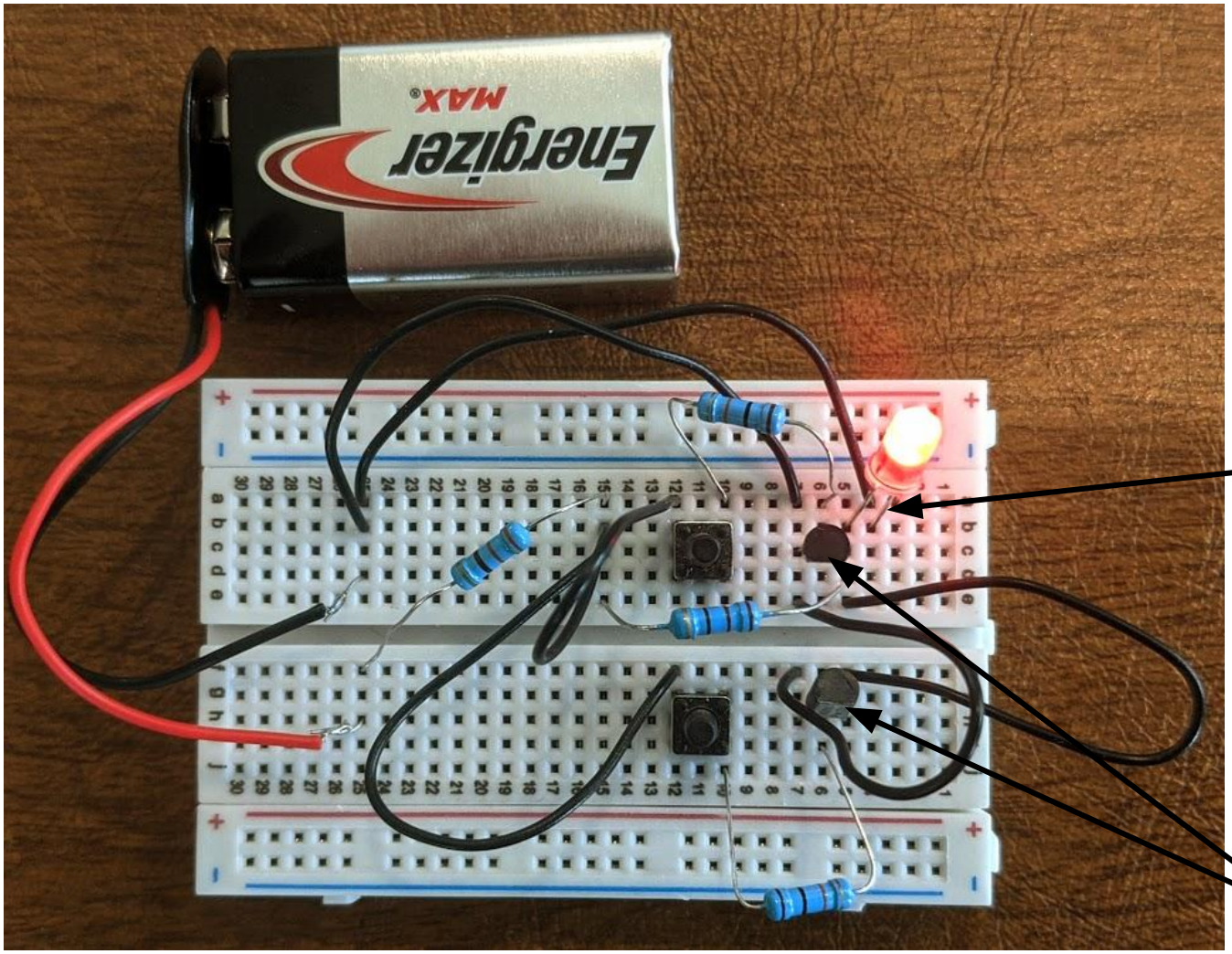
You have now learned how an 'NOR' Logic Gate works and how to build one using electronic components. These are the same type of components used in today's digital circuits.

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.

LAB 3: Computer Theory: Digital Logic Gates

PAGE 2

Assembly Pix for Lesson 6 “The ‘NOR’ Logic Gate”



PAGE 3

S1

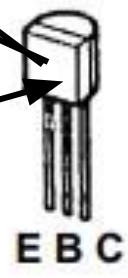
S2

Cathode

Q1

Q2

PAGE 3



Flat side

Lesson 3 - The ‘NOR’ Gate