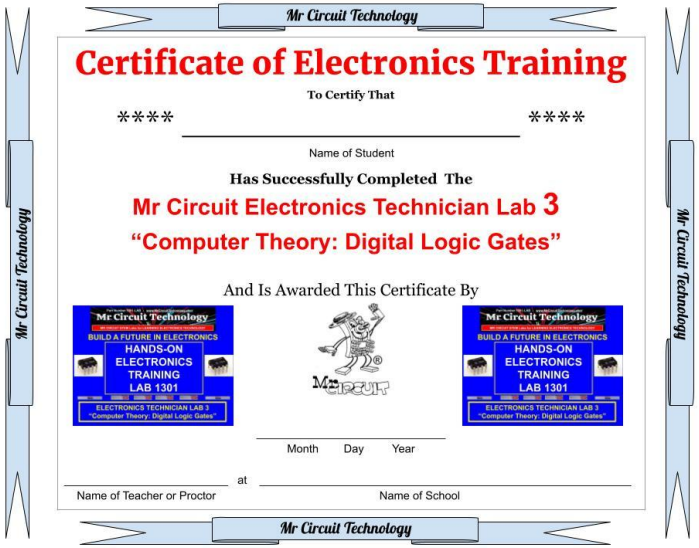
COVER

This is the *EIGHTH* 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

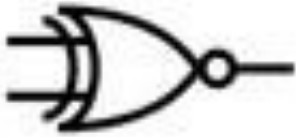
08 00 COVER 1301-SL8

Basic Electronics LAB 3

Digital Logic Gates for future Engineers and Techs

Lesson 8

The 'XNOR' Logic Gate

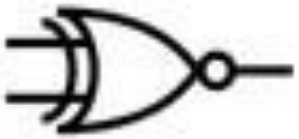
INPUTS  OUTPUT

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

Booklet Number 1301-SL8

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

Here is the logic symbol for a **'XNOR' Logic Gate,** also called an **Exclusive NOR Gate,** which has two inputs. With the 'XNOR' Gate, the output is Hi only if both inputs are the same, either a HI or a LO.

INPUTS  **OUTPUT**

Notice that on the Truth Table of the 'XNOR' Gate, when both inputs are the same the output is HI. Here are the Truth Tables for the 'XOR' Gate and the 'XNOR' Gate which are inverses of each other so you can compare the two.

Truth Table for the 'XOR' Gate

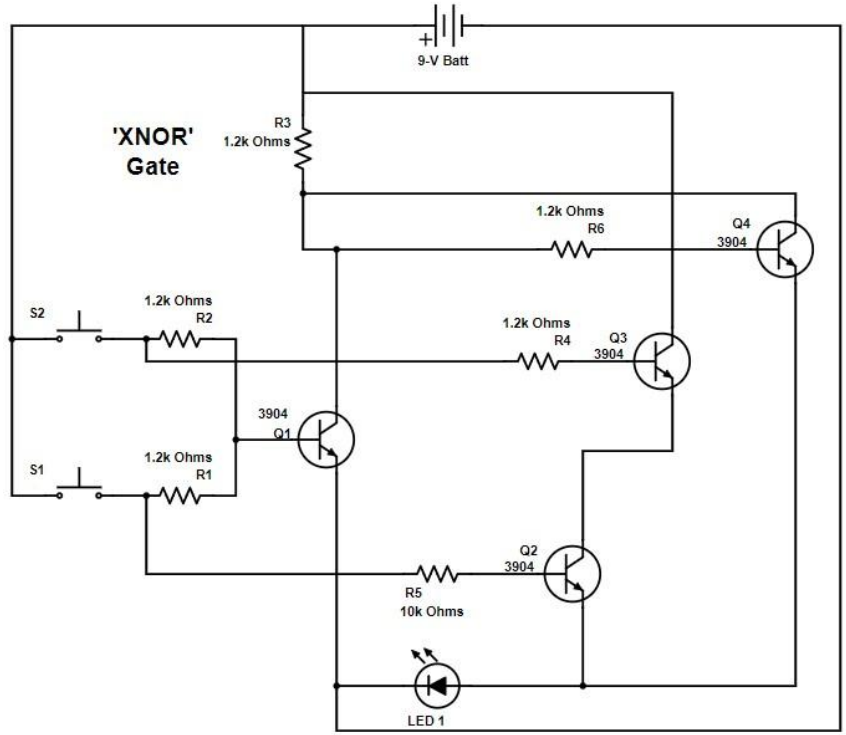
Input A	Input B	Output Q
0	0	0
0	1	1
1	0	1
1	1	0

Truth Table for the 'XNOR' Gate

Input A	Input B	Output Q
0	0	1
0	1	0
1	0	0
1	1	1

LAB 3: Computer Theory: Digital Logic Gates

Here is a schematic of an electronic circuit that performs the function of a **'XNOR' Logic Gate**.



Explanation of the circuit: This circuit has four transistors. When the LED is lit, it indicates a HI on the output of the gate. As soon as you connect the battery, Q4 is forward-biased and causes the LED to light up. If you press S1, which forward-biases Q1, it removes the forward-bias from Q4, causing the LED to turn off. A similar thing happens when you press S2.

If you press S1 and S2 simultaneously, you put a forward-bias Q1 and a forward-bias on Q2 and Q3 which will give a new current path through Q2 and Q3 to light up the LED.

Now, use the QR Code to watch video Lesson 8. Then, using pages 2 and 3 in this booklet, build a **'XNOR' Logic Gate circuit.**

Step-by-Step Assembly Guide for "The 'XNOR' Logic Gate"

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

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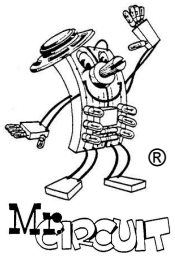
Step 2: Find the Experiment Parts Bags for the Mr Circuit Lab 3

Step 3: Take out the following parts needed to build the **'XNOR'** Logic Gate:

- one Solderless Circuit Board
- one 9-Volt Battery Snap
- one LED (Light Emitting Diode)
- one 1k Ohm resistor (Brown, Black, Red, Gold)
- five 1200 (1.2k) Ohm resistors (Brown, Red, Red, Gold)
- one 330k Ohm resistor (Orange, Orange, Yellow, Gold)
- seven Jumper Wires
- four 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 **Q1** Emitter in 7b, Base in 8b, Collector in 9b
__ **Install** the NPN transistor **Q2** Emitter in 13c, Base in 14c, Collector in 15c
__ **Install** the NPN transistor **Q3** Emitter in 15b, Base in 16b, Collector in 17b
__ **Install** the NPN transistor **Q4** Emitter in 20h, Base in 21h, Collector in 22h
__ **Install** the LED, Anode in 13a, Cathode in Negative Buss
__ **Install** a 1000 Ohm resistor **R6 from** 21j to 22j
__ **Install** four 1200 Ohm resistors: __ **R1 from** 8f to 8e, and __ **R2 from** 12f to 8d, and __ **R3 from** Positive Buss to 22h, and __ **R4 from** 12j to 16d
__ **Install** a 330k Ohm resistor **R5 from** 8j to 14e
__ **Install** a Jumper Wire in Positive Buss to Positive Buss across board
__ **Install** a Jumper Wire in Positive Buss to 6j __ **and another** Positive to 10j
__ **Install** a Jumper Wire in Negative Buss to 7a __ **and another** in 9c to 22f
__ **Install** a Jumper Wire in 17a to Positive Buss __ **and another** in 13e to 20g
__ **Install** the Battery Snap, Red in Positive Buss, Black in Negative Buss
__ **Install** the two Normally-Open Pushbutton switches with 4 legs. Install the legs as shown here.



6g 8g
6i 8i

Switch S1

10i 12i
10g 12g

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 turn off? ____

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

Step 8: Now, press both switches, at the same time. Did the LED remain on?_____ .

Step 9: Conclusion: You should have observed that this circuit works like an **'XNOR' Logic Gate.**

When you press either S1 or S2 alone, it turns the LED off indicating a LO on the output.

When you press S1 and S2 simultaneously, the LED remains on indicating a HI on the output. If neither S1 nor S2 is pressed, the LED remains on, indicating a HI on the output.

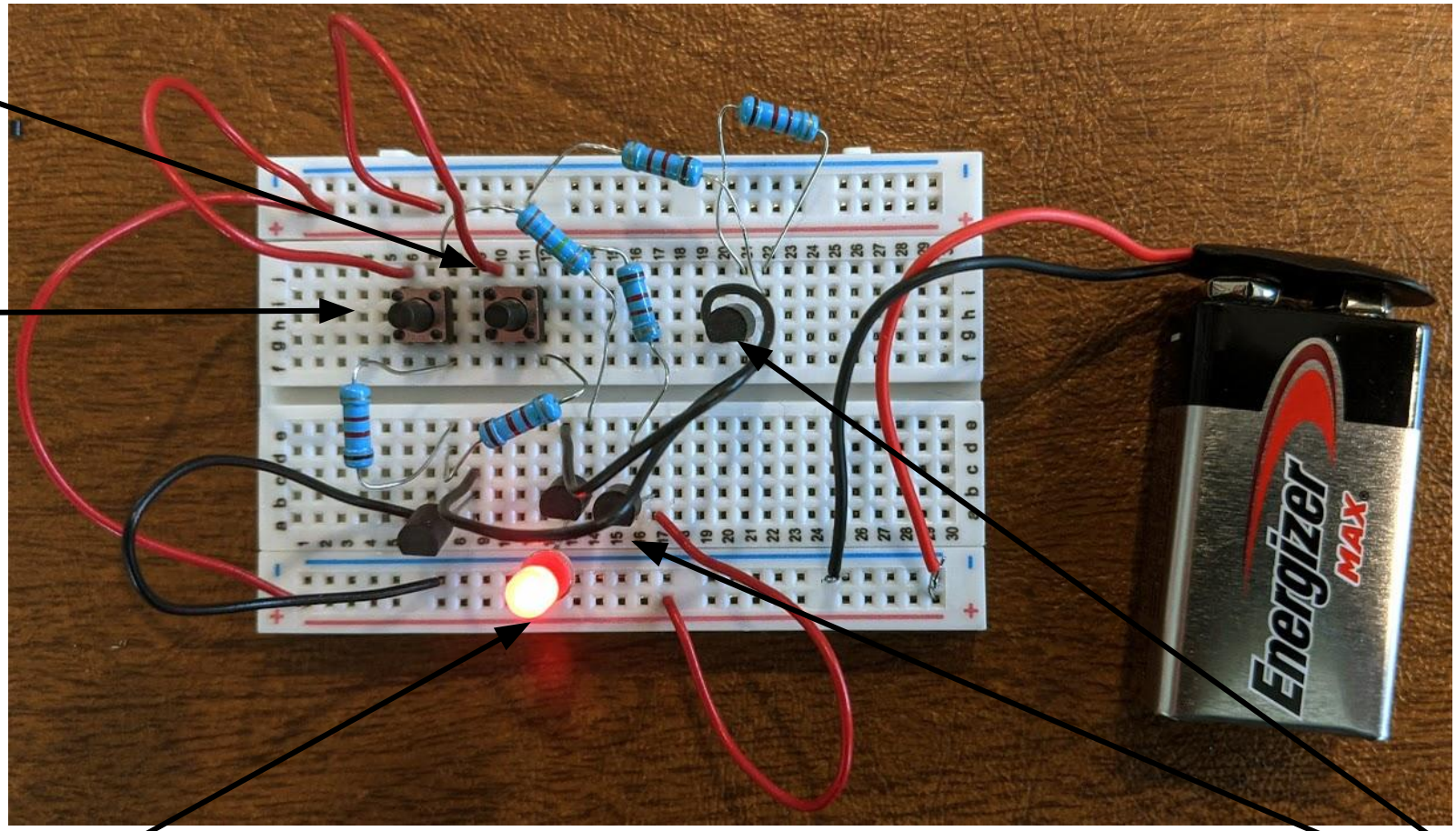
You have now learned how an **'XNOR' Logic Gate** works and how to build one using electronic components. These are the same type of components used in today's digital circuits.

Step 10: Now, disassemble the circuit and put all the parts back into the plastic bag.

LAB 3: Computer Theory: Digital Logic Gates

PAGE 2

Assembly Pix for Lesson 8 "The 'XNOR' Logic Gate"



PAGE 3

PAGE 3

Lesson 3 - The 'XNOR' Gate

LAB 3: Computer Theory:
Digital Logic Gates