Lab 10 – Logic Gates

Physics 242 – Electronics

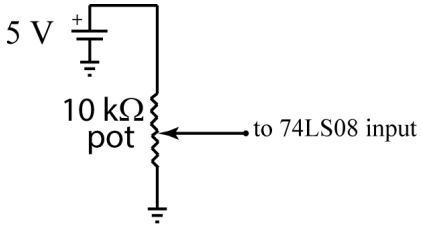
Introduction

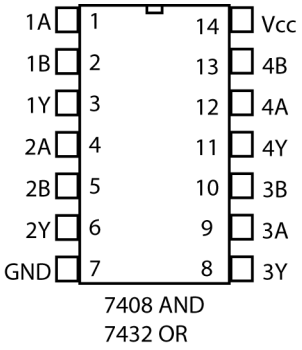
Logic gates perform the fundamental operations of Boolean algebra, AND, OR, and NOT, along with some variations such as XOR (exclusive OR) and NAND (NOT AND). The gates are made using a relatively small number of transistors (<20) and are available as inexpensive integrated circuits (ICs).

Procedure and Questions

I. AND gate

The pin connection diagram for a 74LS08 quad positive AND gate is shown below. Note the connections for 5V power (V_{cc}) and ground. First verify the operation of your AND gate by cycling the inputs through all combinations and measuring the voltage at the output. Then make the following measurements:





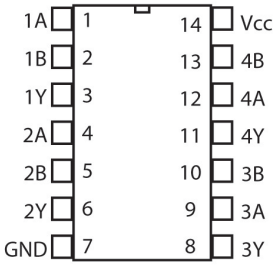
(1) Measure the threshold voltage for the output to make a transition between L (low) and H (high) states. Use the 5 V power supply on the breadboard and the 10 kΩ potentiometer to supply a variable input voltage, via the circuit shown above. The other input should be H (5 V).

(2) Measure the output voltage when the output load is (a) open, (b) 1 kΩ, (c) 100 Ω.

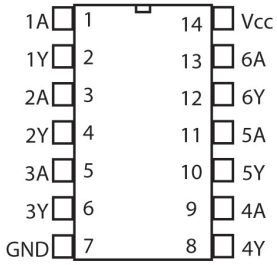
(3) Determine if unconnected inputs count as H or L.

In your report, give your results for the above measurements. Calculate the output current the chip provided to the 1 kΩ and 100 Ω loads.

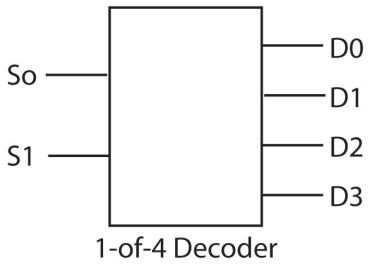
(over)



7408 AND
7432 OR



7404 Inverter



1-of-4 Decoder

II. 1-of-4 Decoder

In this part, you will build a circuit that functions as a 1-of-4 decoder. The function is illustrated schematically above. The input to the circuit is a 2-bit address S_1S_0, which can select 4 different outputs: the output line addressed by the input is raised HIGH and the other output lines are held LOW. A truth table (also known as a function table) for the decoder is given below. You may use any available logic gates to implement your circuit; it is convenient to build it using AND, OR, and NOT gates. Pin connection diagrams for the 74LS04 hex inverter (NOT) and 74LS32 (quad positive OR) are shown above. Use the convenient data switches on the bottom of your breadboard for the address inputs S_0 and S_1. Use the indicator lamps (LEDs) on the top of the breadboard for the display of the output data lines. In your report, include a neatly-drawn diagram of your logic circuit. Each group should demonstrate their operational circuit to the instructor.

S_1	**S_0**	**D_3**	**D_2**	**D_1**	**D_0**
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0