**Lab – Decoders**

Digital Decoders are devices used to detect a specific combination of bits on its inputs and indicate the presence of this bit combination with a specified output level. The most basic binary decoder can be made up of a combination of ‘AND’ and Inverter gates.

**Objectives:**

-To build a decoder circuit and determine what it does

-To determine how to convert a binary code decimal (BCD) number to a decimal

-To construct a circuit that decodes a BCD number and displays it on a seven segment display

**Pre-Lab:**

-Convert the following BCD numbers to a decimal. Show your work below.

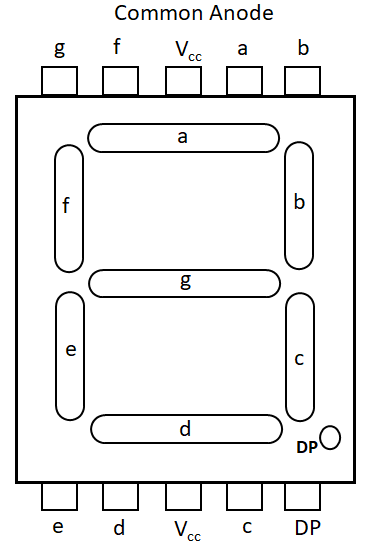
a. 0101

b.0110

c.0111

**Equipment:**

One 7404 Hex Inverter; One 4081 Quad AND Gate; One 7447A BCD/Decimal decoder; Eleven 330 or 300 Ohm resistors; 1 kOhm resistor; One 4 position DIP switch.; four LED; One seven segment display LSD 5061-11 Common Anode

IC Pin Diagrams

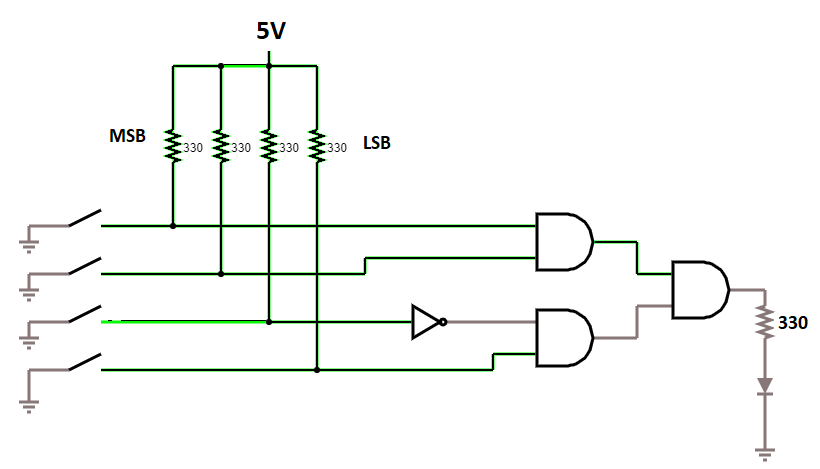
A picture containing text, measuring stick

Description automatically generated

***Figure 1 –*** *Pin layout Diagrams for IC 7447 and 7 Segment Display*

**Procedure**

1.Use the pin diagram and wire up the circuit below. Note that the circuit uses three AND gates and one inverter gate.

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***Figure 2 –*** *Decoder Circuit[[1]](#endnote-1)*

2.Make sure that you know which pins of the IC are the inputs and which are the outputs. Also, be sure you are applying power (Vcc) and ground to the correct pins otherwise your circuit will not function. The value of Vcc should be 5 Volts.

3. Turn the DIP switches on and off to determine the 4 bit number that lights up the LED

4. In your notebook briefly explain what you did in this activity and what you found.

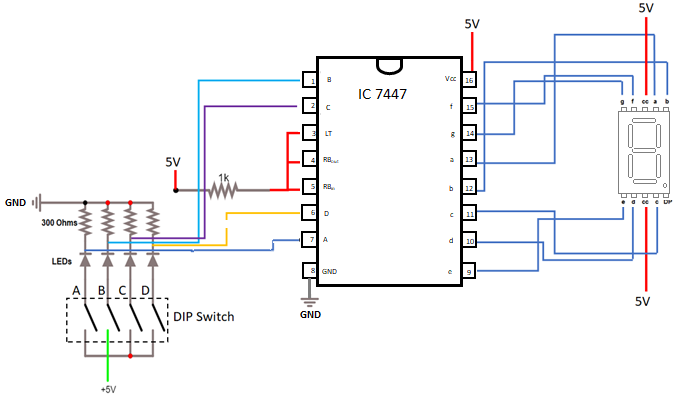
**Questions**

1. What 4 bit number did you find resulted in a HIGH at the output of the right most AND gate?
2. Let’s say you wanted to detect the number 1001. How would you modify the decoder circuit above?

**Mini-Project**

Decoders are used extensively by computers to communicate with external devices like monitors, printers, keyboards, etc. through input and output ports. They are used to select the input/out ports to allow binary messages to be sent to a particular external device. Decoders are also used to convert a number from one type of number system to another such as from binary to decimal so that the values are easily read by humans.

In this activity you will build a BCD to Decimal converter using a decoder (7447A) and display that number using a seven-segment display. Construct the circuit below and make it display all numbers from zero to nine. **Note:** In the schematic below, it is recommended that each segment of the seven segment display be connected to 300 ohm resistors to limit the current.



***Figure 3 –*** *BCD to Decimal Converter using a Decoder and 7-Segment Display*

1. All schematic diagrams were created with Falstad circuit simulator (https://falstad.com/circuit/) [↑](#endnote-ref-1)