ECE 270 Lab Verification / Evaluation Form

Experiment 1

Evaluation:

IMPORTANT! You must complete this experiment during your scheduled lab period. All work for this experiment must be demonstrated to and verified by your lab instructor *before the end* of your scheduled lab period.

STEP	DESCRIPTION	MAX	SCORE
1	Power and Ground Jumper Installation	2	
2	DIP Switch and Pull-up SIP Wiring	2	
3	Inverter and LED Test	2	
4	NAND, NOR, AND, and XOR Truth Tables	8	
5	Schematic Capture	8	
6	What-If Test	3	
	TOTAL	25	

Signature of Evaluator: _____

Academic Honesty Statement:

IMPORTANT! Please carefully read and sign the Academic Honesty Statement, below. *You will not receive credit for this lab experiment unless this statement is signed in the presence of your lab instructor.*

"In signing this statement, I hereby certify that the work on this experiment is my own and that I have not copied the work of any other student (past or present) while completing this experiment. I understand that if I fail to honor this agreement, I will receive a score of ZERO for this experiment and be subject to possible disciplinary action."

Last Name (Printed): _____ **Lab Div:** _____ **Date:** _____

E-mail: __ __ __ __ __ __ __ __ @purdue.edu **Signature:** _____

Breadboard Techniques and Logic Function Demonstration

Instructional Objectives:

- To become familiar with the contents of the *Digital Parts Kit* (DK-2)
- To learn how to build and test digital circuits using the Breadboard Kit (BB-1)
- To learn about basic logic functions such as AND, OR, NOT, NAND, NOR, and XOR

Prelab Preparation:

- Purchase the parts kits for lab and identify each component

Lecture/Demonstration:

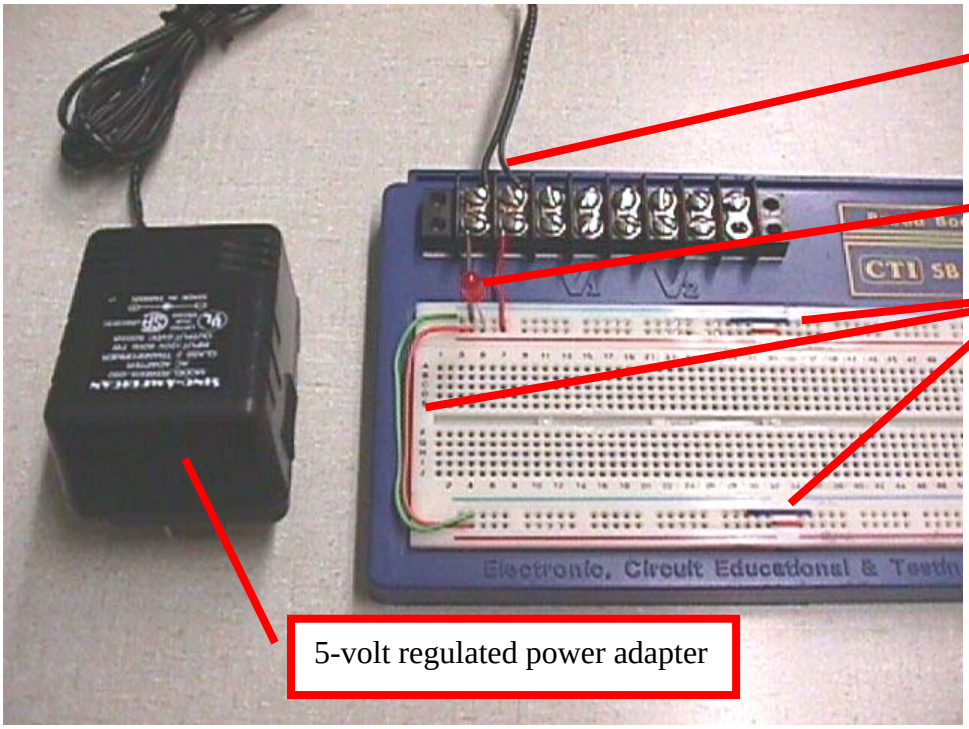
Your lab instructor will give a brief presentation that includes the following:

- An overview of the components in your DK-2 kit
- An explanation of how to read part numbers and interpret resistor values
- An explanation of how your BB-1 breadboard is organized
- A demonstration of how to connect a 5 VDC power supply to your BB-1 breadboard and how to measure the supply voltage to make sure it is connected correctly
- A demonstration of where and how to install power and ground jumpers on your BB-1 breadboard
- A demonstration of how to connect the mini-DIP switch and the 10K ohm pullup resistor SIP
- A demonstration of how to connect and test LEDs
- A demonstration of how to insert and remove integrated circuits from the BB-1 breadboard, along with an explanation of the precautions that should be taken in handling CMOS ICs
- An explanation of how integrated circuit pins are numbered, along with an explanation of where data sheets on ICs can be found
- A demonstration of OrCAD Capture

Step (1): Power and Ground Jumper Installation

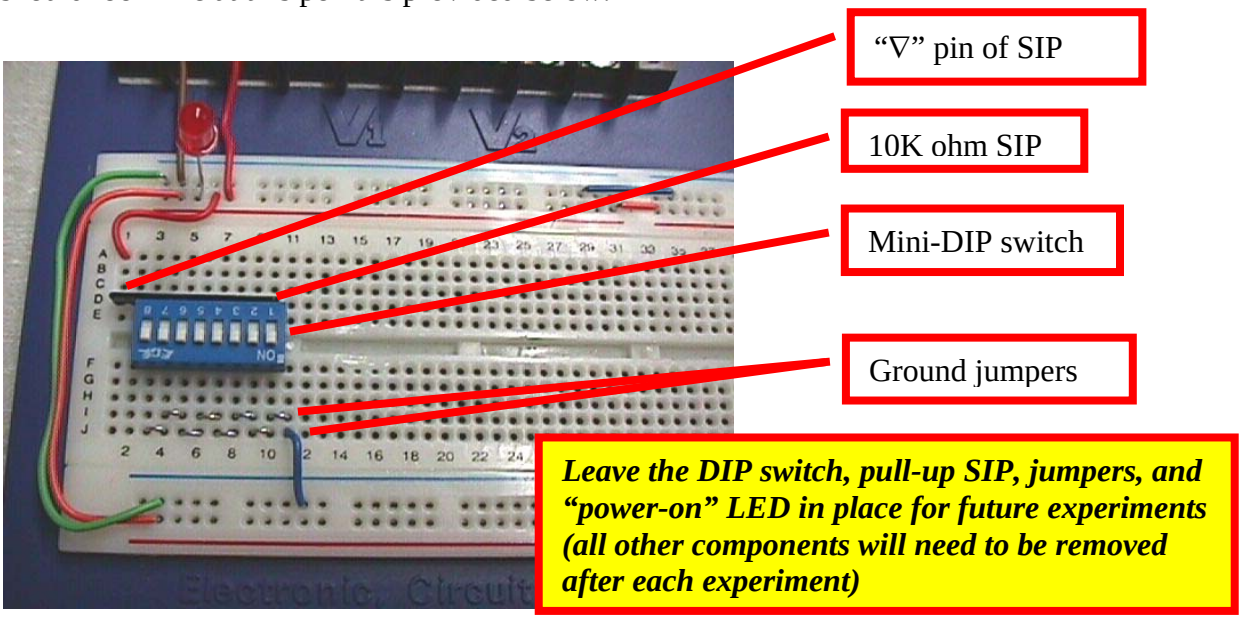
Connect the power and ground jumpers on your BB-1 breadboard to the barrier strip, as demonstrated by your lab instructor. Then, connect the power and ground "rails" of your breadboard to the barrier strip. If you bought a 5-volt regulated power adapter, connect it to the barrier strip; the "white-striped" lead is power (+5 VDC), the non-striped lead is ground. Otherwise, simply connect two reasonably long wires to the barrier strip so that your board can be connected to one of the lab power supplies. IMPORTANT: Before connecting anything else to your breadboard, measure the voltage distributed on the supply rails of your board using the digital multi-meter ("DMM") at your lab station, making sure that the "red rail" is +5 VDC and that the "blue rail" is ground. Once you are satisfied that the power and ground rails are configured correctly, connect a red (resistor) LED between the power and ground rails in the "upper left hand corner" of your board to serve as a "power on" indicator. (NOTE: The "long" lead of the LED is the anode, which should be connected to "red rail".) **This will hopefully serve as a reminder to ALWAYS turn OFF power to your board BEFORE inserting or removing ANY parts or wires.** An illustration of what your board should look like at this point appears at the top of the page that follows.

<u>Trouble-Shooting Tip</u>: Always disconnect (or turn off) the power supply before making any changes to your breadboard circuit. This will help prevent damage to your ICs.



Step (2): DIP Switch and Pull-up SIP Wiring

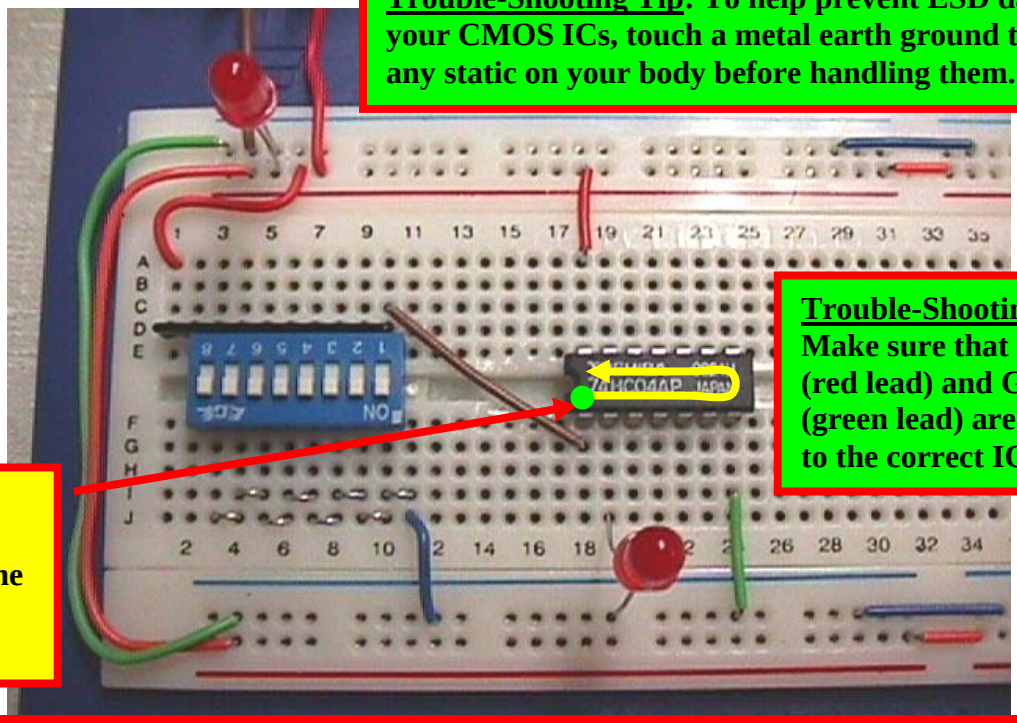
Insert the mini-DIP switch into your board, along with the 10K ohm pull-up SIP, as demonstrated by your lab instructor. Connect the "∇" pin of the SIP to the 5 VDC power supply rail. Connect all the "ON" side pins of the mini-DIP switch to the ground rail. IMPORTANT: Test each switch with the DMM at your lab station to make sure that the switch outputs "0.0 volts" when the switch is in the "DOWN" (or "ON") position, and outputs (approximately) "5.0 volts" when the switch is the "UP" (or "OFF") position. An illustration of what your board should look like at this point is provided below.



Step (3): Inverter and LED Test

You are now ready to demonstrate the functionality of some common logic functions. Locate a 74HC04 (hex inverter) IC in your DK-2 parts kit and insert it into your breadboard as demonstrated by your lab instructor. Connect the 74HC04 to power (pin 14) and ground (pin 7). Connect one of the inputs (pin 1) to one of the DIP switches, and connect the corresponding output (pin 2) to the anode of a RED (resistor) LED (connect the cathode of the LED to ground). Verify that the inverter works as anticipated. An illustration of what your board should look like at this point is provided below.

Trouble-Shooting Tip: To help prevent ESD damage to your CMOS ICs, touch a metal earth ground to discharge any static on your body before handling them.



Trouble-Shooting Tip: Make sure that POWER (red lead) and GROUND (green lead) are connected to the correct IC pins.

Carefully note the location of PIN 1 and the *pin numbering order*

Trouble-Shooting Tip: Use the small screwdriver in your TK-1 toolkit to gently (and symmetrically) remove an IC from the breadboard, being careful not to bend its pins.

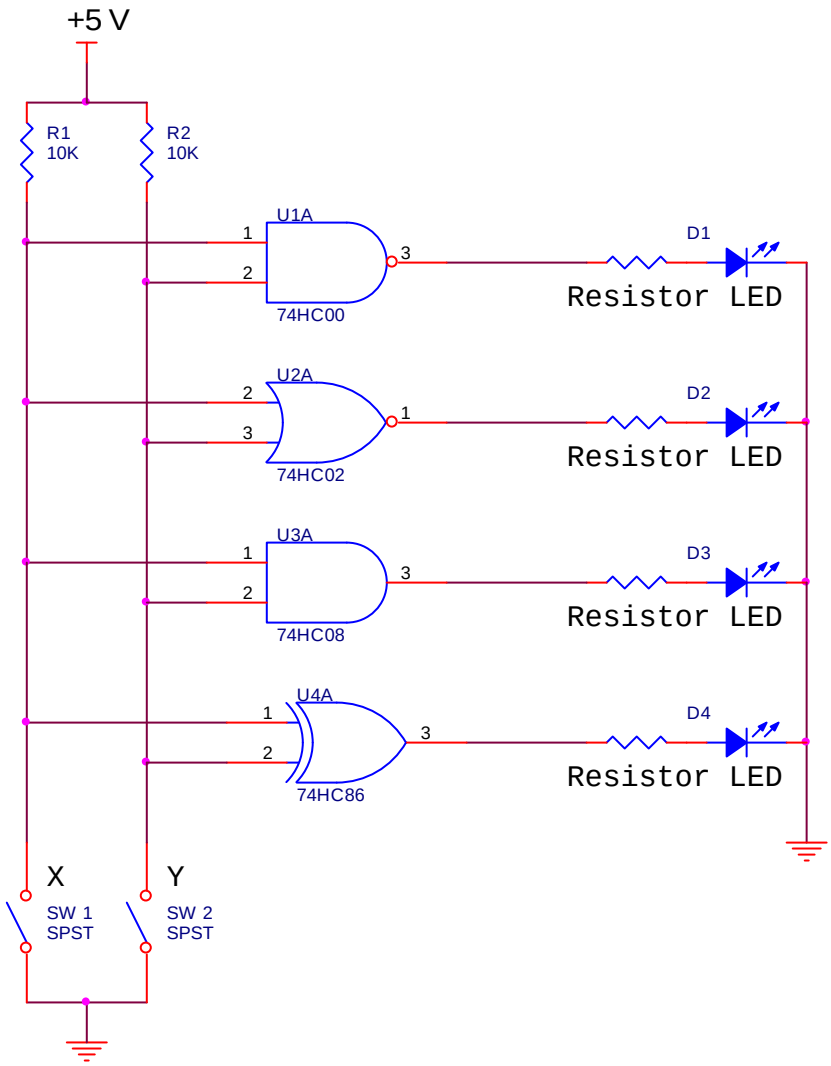
Step (4): NAND, NOR, AND, and XOR Truth Tables

Repeat Step (3), using a 74HC00 (quad 2-input NAND), 74HC02 (quad 2-input NOR), 74HC08 (quad 2-input AND), and 74HC86 (quad 2-input XOR). NOTE: To demonstrate each of these functions, you will need *two* DIP switches, and you will need to test *all four* input combinations. Complete the TRUTH TABLE, below, for each of the four functions (NAND, NOR, AND, XOR) and verify that you obtain the results anticipated.

Inputs X Y	74HC00 NAND	74HC02 NOR	74HC08 AND	74HC86 XOR
0 0				
0 1				
1 0				
1 1				

Step (5): Schematic Capture

Draw a complete schematic of the circuit you implemented for Step (4) using **OrCAD Capture**. This schematic should include all four gates tested, a resistor LED for each gate tested, and two DIP switches (with pull-up resistors). Your completed schematic should look similar to the one below. Attach a printed copy of your schematic to your completed lab experiment.



Step (6): "What-If" Test

Determine what happens if you try to connect an LED directly to the DIP switch/pull-up resistor circuit. First, try connecting the anode of an LED to the switch and the cathode to ground. Next, try connecting the LED's anode to +5 V and its cathode to the switch. Describe the results obtained and explain what is happening in each case.

