

LAB 1: USE OF EQUIPMENTS

A. OBJECTIVE:

1. To familiarize yourself with the basic equipments and components, power supply, multi-meter, transistors.
2. To understand the power limitation of an IC.
3. To understand the use of transistor as a electronic switch
4. To correlate the knowledge that you learn from previous courses to the real world environment.

B. PRE-LAB ASSIGNMENT:

1. Study the Power Supply IPS-3303 information (available from the course webpage).
2. Study the 74LS04 datasheet (available from the course webpage).
3. Study the PN2222 datasheet; note the orientation of Base, Emitter and Collector.
4. Study the tutorial information related to LAB1.
5. Finish the PRE-LAB part of the activity sheet.

C. INTRODUCTION:

In this lab, you need to familiar yourself with the basic tools of electronics.

- Power Supply – A power supply is to provide power to your circuits, you need to be able to understand the operation modes of the power supply. How does it related to Voltage and Current.
- Multi-meter – A meter to measure the voltage and current of your circuit.
- Transistor – A device normally to amplify the current from the digital logic system.

D. POWER SUPPLY INFORMATION:

The following are the photos for the power supply that is actually used in the lab Model IPS-3303.



Please refer to the Canvas for more information about the Power Supply

ELEC 3300

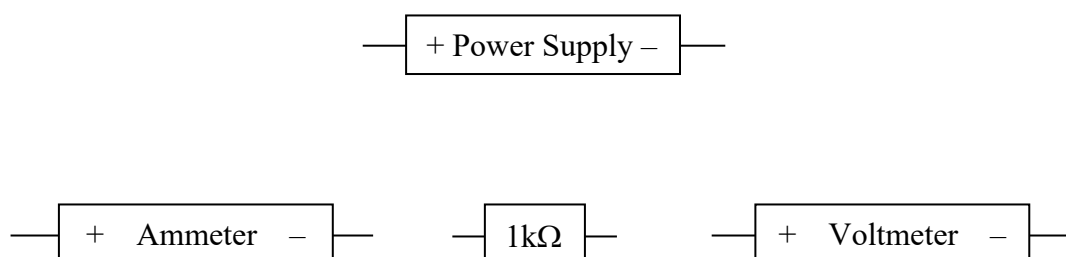
LAB 1 : USE OF EQUIPMENTS

ACTIVITY SHEET

Name : _____ Student number : _____ LAB Session : _____

PRE-LAB

Consider the circuit below that consist of a $1k\Omega$ resistor, a power supply, an ammeter and a voltmeter. If you want to measure the voltage and current across the resistor. How do you connect the ammeter and voltmeter? **WARNING ** If you connect WRONGLY, you will DAMAGE the EQUIPMENT, so, if you are not sure, please ASK your best friend, Google!!**



Please check the following components before you start each Part of the LAB

Check List

	Components / Equipment	Tested Result	
Part A	Power Supply	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	100Ω resistor	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	10Ω resistor	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	470Ω resistor	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
Part B	LED	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	10Ω resistor	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	74LS04 IC	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	Digital Multimeter	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
Part C	Motor	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	74LS04 IC	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	NPN Transistor	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK

A. Power Supply:

WARNING ** Part A requires you to set the Voltage and Current according to your student ID. Please double check your voltage and current before you connect the resistor and do the measurement.

Assume your student ID is

2	0	1	2	3	4	5	6
a	b	c	d	e	f	g	h

Please set the maximum voltage to Y volt, where $Y = (g \times 10 + h) \bmod 5 + 4$

Please set the maximum current to 0.Z A, where $Z = (e \times 10 + f) \bmod 2 + 2$

Example:

For above student ID, the maximum voltage will be $= (5 \times 10 + 6) \bmod 5 + 4 = 5V$

For above student ID, the maximum current will be $= (3 \times 10 + 4) \bmod 2 + 2 = 2 \rightarrow 0.2A$

What is the maximum Voltage, Current and Power that delivered by the power supply from the setting according to your student ID? **Show your calculation.**

Voltage : _____

Current : _____

Power : _____

Now,

Turn on the Power supply
Enable the output



Consider the **independent mode and the master supply only**. In order to set the maximum power of the supply, you need to do the two steps below **separately**.

- I. Set the maximum voltage to Y Volt by the voltage knob **under an open circuit condition**.
- II. **Shorting the outputs** and set the maximum current to 0.Z A by the current knob.

**PLEASE FOLLOW ABOVE STEPs to SET THE MAX VOLTAGE AND CURRENT.
DO NOT JUST SIMPLY READ THE VALUE WHEN THE OUTPUT IS DISABLED.**

1. Take the 100Ω from the box, measure the actual resistance using a multimeter.

Ans: _____

Connect the 100Ω resistor across the +ve and –ve terminals of the power supply, read the voltage and the current drawn from the power supply from the power supply display, hence calculate the power delivered by the power supply.

Ans: _____

Which mode (CC or CV) is the power supply operates in?

Ans: _____

Now, refer to PRE-LAB, measure the Voltage, Current across the 100Ω resistor by using DMM, hence calculate the power dissipated by the 100Ω resistor.

Ans: _____

Does power delivered by the power supply equals to the power dissipated by the resistor? Is the conservation of energy holds?

Ans: _____

Repeat the previous steps with a 10Ω resistor.

Take the 10Ω from the box, measure the actual resistance from the multimeter.

Ans: _____

Connect the 10Ω resistor across the +ve and –ve terminals of the power supply, which mode (CC or CV) is the power supply operates in?

Ans: _____

From the display, read the voltage and the current drawn from the power supply.

Ans: _____

Why the displayed voltage value differs from the value that you set (i.e Y Volt) before?

Ans: _____

Calculate the power dissipated by the 10Ω resistor.

Ans: _____

2. Keep the same setting but **change the 10Ω resistor to a wire connecting the 2 output terminals.**

Which mode (CC or CV) is the power supply operates in?

Ans: _____

From the display, read the voltage and the current drawn from the power supply.

Ans: _____

Why the displayed voltage value differs from the value that you set (i.e Y Volt) before?

Ans: _____

Any current flow between the +ve terminal to –ve terminals? If yes, what is the value, if no, why?

Ans: _____

Any voltage difference between the +ve terminal to –ve terminals? If yes, what is the value, if no, why?

Ans: _____

Is Ohm's Law valid in this condition? Explain briefly.

Ans: _____

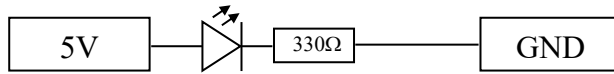
3. **Configure the Power Supply to series mode and output –Y Volt to +Y Volt**, connect a **470 Ω** resistor to the output terminals, **set appropriate current so that the Power Supply operates in CV mode**. Measure the voltage, current across the 470 Ω resistor and hence calculate the power delivered to the 470 Ω resistor.

Ans: _____

Check point 1, TA Signature for finishing Part A: _____

B. Digital Circuit:

1. Consider the independent mode and the master supply only. Set the voltage to **5V** by open circuit, set current to **0.3A** by shorting the outputs.
2. In your breadboard, build the following circuit.



From your knowledge in the other courses, assume the LED is an ideal diode with a 0.7V for forward bias, what should be the current flowing through the 330Ω resistor?

Ans: _____

Now, measure the exact current through the 330Ω resistor using a desktop multi-meter, what is the reading?

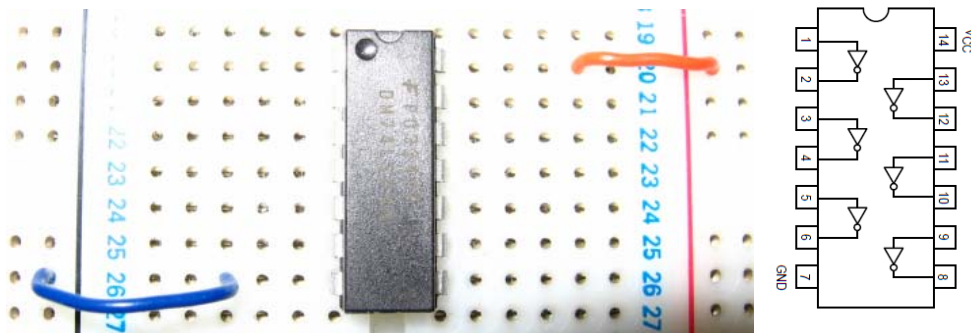


Ans: _____

With the knowledge that you learnt from the other courses, comments on the two measurements above if the assumption on 0.7V bias is valid or not.

Ans: _____

Now, consider a 74LS04 (Hex NOT Gates) IC.



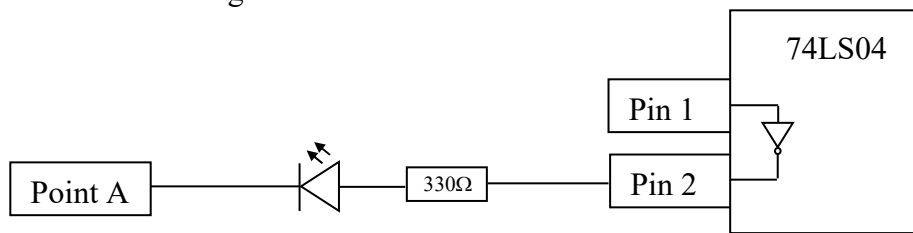
3. Connect Pin 1 to GND, measure the voltage at Pin 2. What is the voltage at Pin 2?

Ans: _____

4. Connect Pin 1 to 5V, measure the voltage at Pin 2. What is the voltage at Pin 2?

Ans: _____

5. Now, make the following connections:



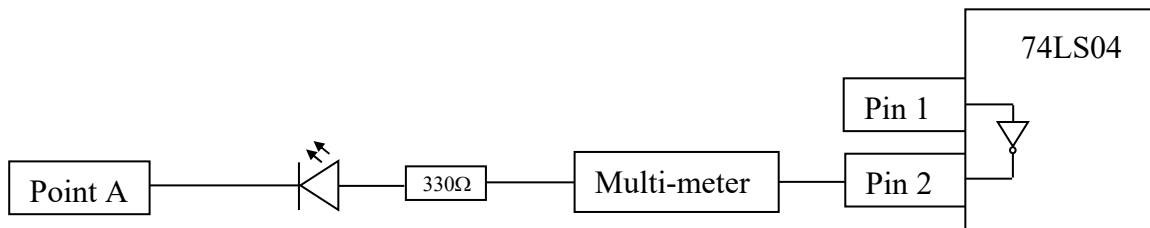
In order to light up the LED, what should Pin 1 and Point A be connected to?

Ans: Pin 1 connected to (5V / GND), Point A connected to (5V / GND)

In this example, the current that lights up the LED flows from where to where?

Ans: Current flows from _____

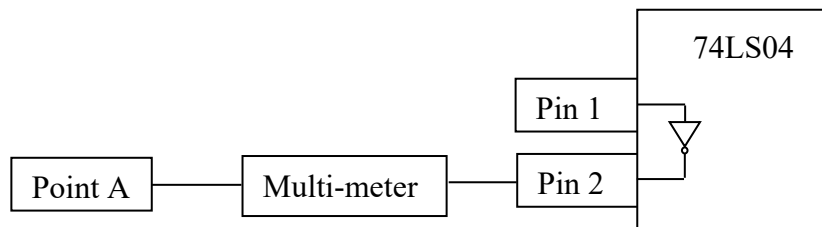
Now, use a multi-meter to measure the current. Please note the +ve and -ve terminals of the multi-meter.



What is the current shown on the multi-meter? Is the current flowing out from Pin 2 or flowing into the Pin 2?

Ans: Current shown on multi-meter: _____. Direction: (out from / into) Pin 2

Now, try to directly connect pin 2 through the multi-meter to Point A, measure the current again. Is the current flowing out from Pin 2 or flowing into the Pin 2?

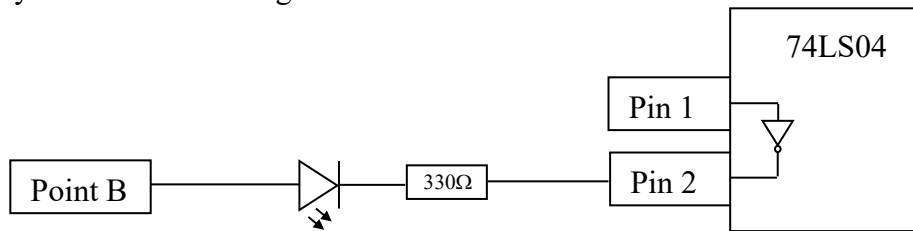


Ans: Current shown on multi-meter: _____. Direction: (out from / into) Pin 2

The above method will allow you to know the maximum current supplied by the IC. With your answer from Part B3, deduce the maximum power you can get from Pin 2.

Ans: Maximum Power from Pin 2: _____

6. Now, try to make little changes:



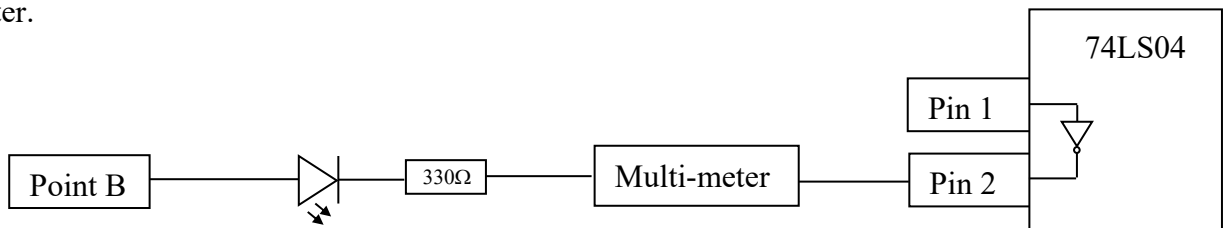
In order to light up the LED, what should Pin 1 and Point B connected to?

Ans: Pin 1 connected to (5V / GND), Point B connected to (5V / GND)

In this example, the current that lights up the LED flows from where to where?

Ans: Current flows from _____

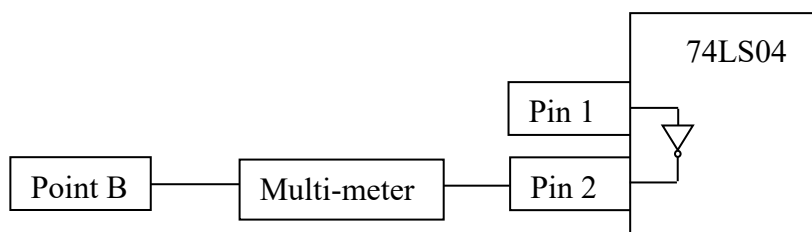
Now, use a multi-meter to measure the current. Please note the +ve and –ve terminals of the multi-meter.



What is the current shown on the multi-meter? Is the current flowing out from Pin 2 or flowing into the Pin 2?

Ans: Current shown on multi-meter: _____. Direction: (out from / into) Pin 2

Now, try to directly connect pin 2 through the multi-meter to Point B, measure the current again. Is the current flowing out from Pin 2 or flowing into the Pin 2?



Ans: Current shown on multi-meter: _____. Direction: (out from / into) Pin 2

The above method will allow you to know the maximum current sink by the IC.

Refer to Start of Part B, the maximum current from the Power Supply is set to 0.3A. Does Pin 2 allow all the 0.3A current sink to it? Please comment.

Ans: _____

Check point 2, TA Signature for finishing Part B: _____

Check List

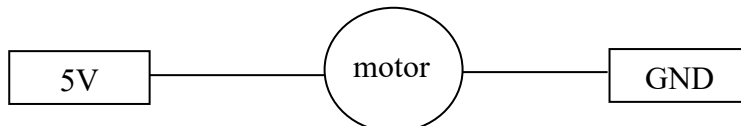
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Part B	LED	<input checked="" type="checkbox"/> OK	<input type="checkbox"/> NOT OK
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	74LS04 IC	<input checked="" type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	Digital Multimeter	<input checked="" type="checkbox"/> OK	<input type="checkbox"/> NOT OK
Part C	Motor	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	74LS04 IC	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
	NPN Transistor	<input type="checkbox"/> OK	<input type="checkbox"/> NOT OK

C. Transistor as an amplifier or a switch

1. Consider the independent mode and the master supply only. Set the voltage to **5V** by open circuit, set current to **0.35A** by shorting the outputs.
2. Measure the resistance of the motor

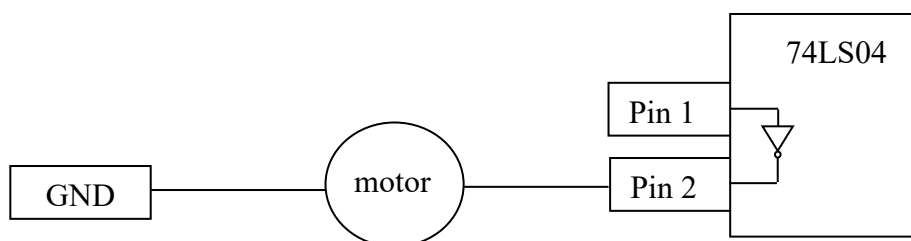
Ans: Resistance of the motor _____

3. Connect the 2 wires of the motor directly to the power supply. Read the voltage and current reading from the power supply.



Ans: Voltage: _____ Current: _____

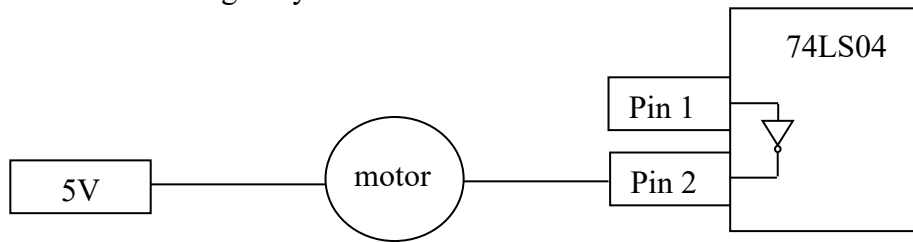
4. Use the circuit that you build from Part B, make the following connections:



Will the motor turn when you connect the Pin 1 to GND? Please explain with the answer of you get from last task of Part B 5. **DO NOT USE YOUR HAND TO ROTATE THE MOTOR**

Ans: _____

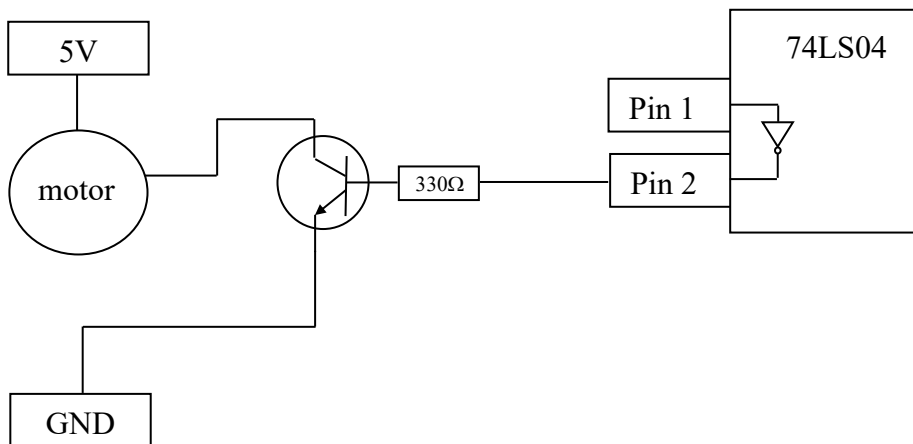
5. Now, make a little change to your circuit:



Will the motor turn when you connect the Pin 1 to 5V? Please explain with the answer of you get from last task of Part B 6. **DO NOT USE YOUR HAND TO ROTATE THE MOTOR**

Ans: _____

6. Now, modify and adding a NPN transistor to your circuit as follows:



Will the motor turn when you connect the Pin 1 to 5V? Please explain with the properties of the transistor.

Ans: _____

Will the motor turn when you connect the Pin 1 to GND? Please explain with the properties of the transistor.

Ans: _____

When the motor is on, read the current from the power supply, compare to your answer from Part C 3.

Ans: _____

In this example, the power that makes the motor move comes from where?

Ans: Power comes from: _____

What is the role of Pin 1 of 74LS04 in this example?

Ans: _____

Check point 3, TA Signature for finishing Part C: _____