

ELEC 3300 – Tutorial for LAB1

Department of Electronic and Computer Engineering
HKUST

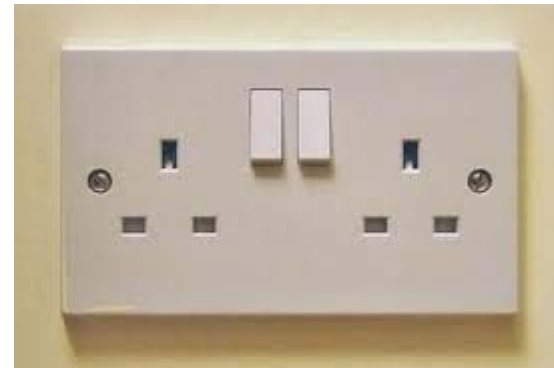
by WU Chi Hang 

About LAB 1

- In LAB 1, you are required to familiar yourself with some basic equipment
 - Power Supply
 - Digital Multi-meter
 - Transistor

Power Supply

- What is a Power Supply ?
- A Power Supply should give out ?
- Power =
- For HK Socket
 - Do you know the Voltage ?
 - Do you know the Current ?



Power Supply

- Are they called power supply ?



- ❑ Do you know the Voltage ?
- ❑ Do you know the Current ?

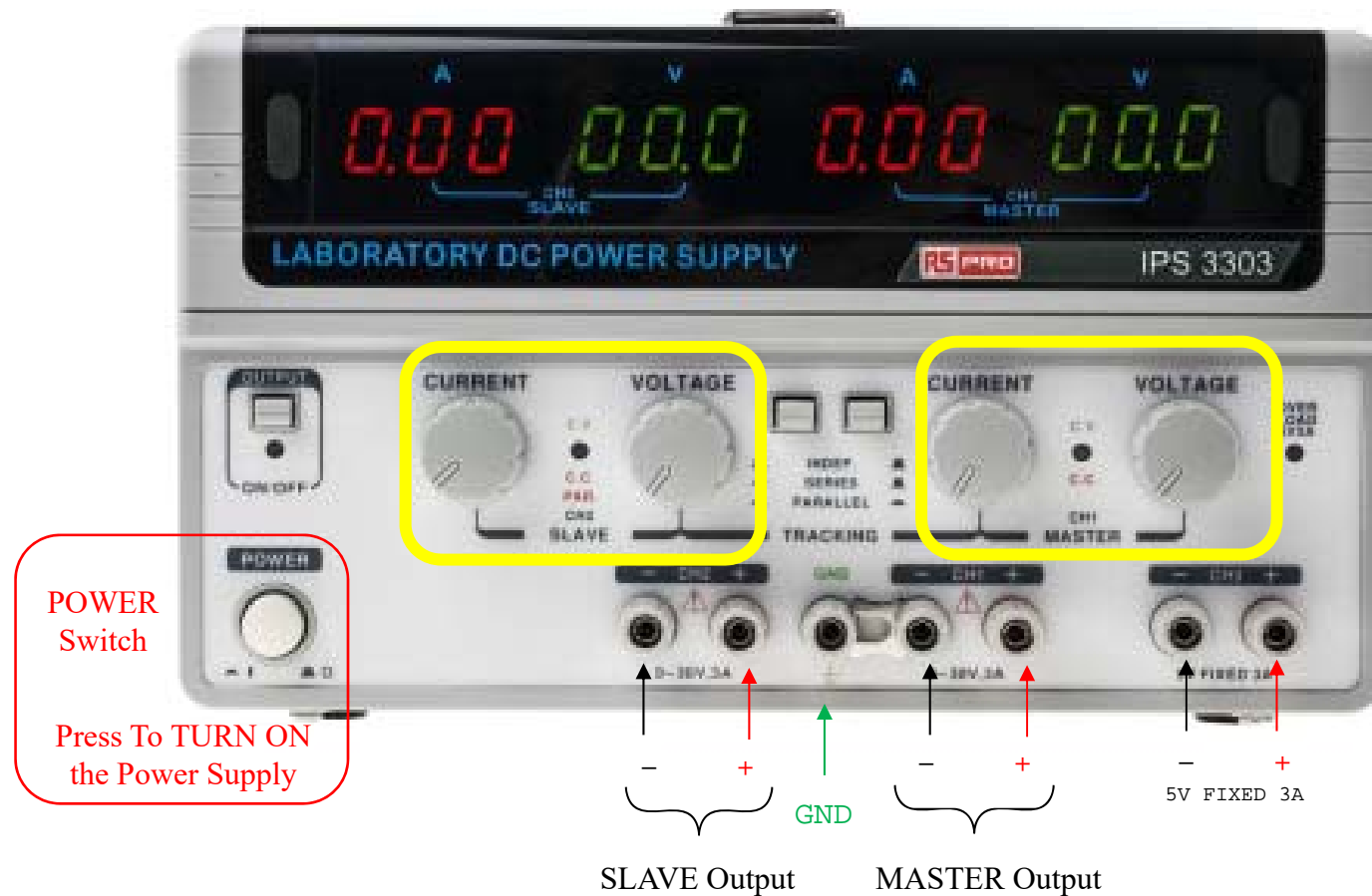
Power Supply – POWER Switch

Display for SLAVE

Current Voltage

Display for MASTER

Current Voltage



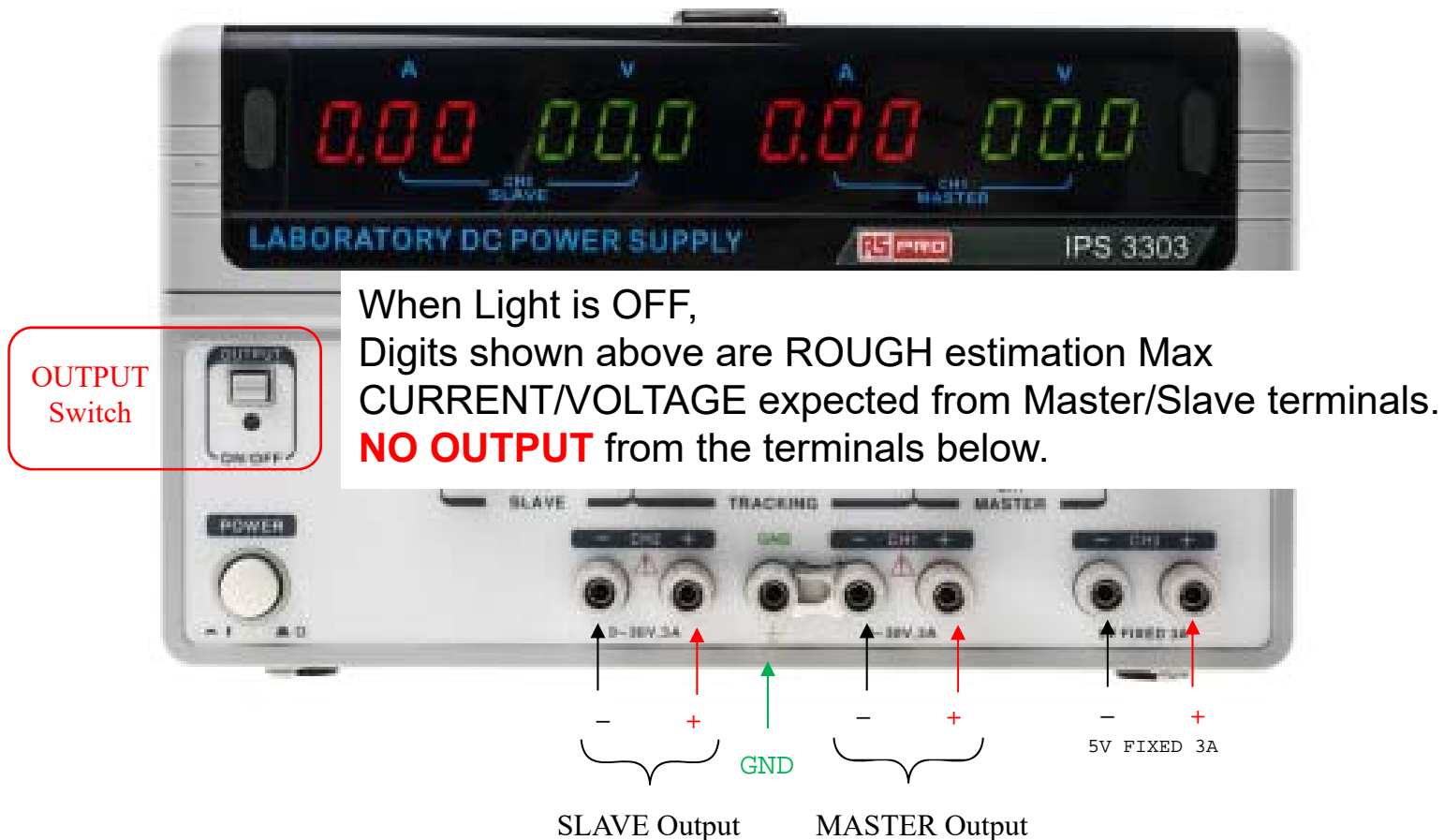
Power Supply – OUPUT Switch OFF

Display for SLAVE

Current Voltage

Display for MASTER

Current Voltage



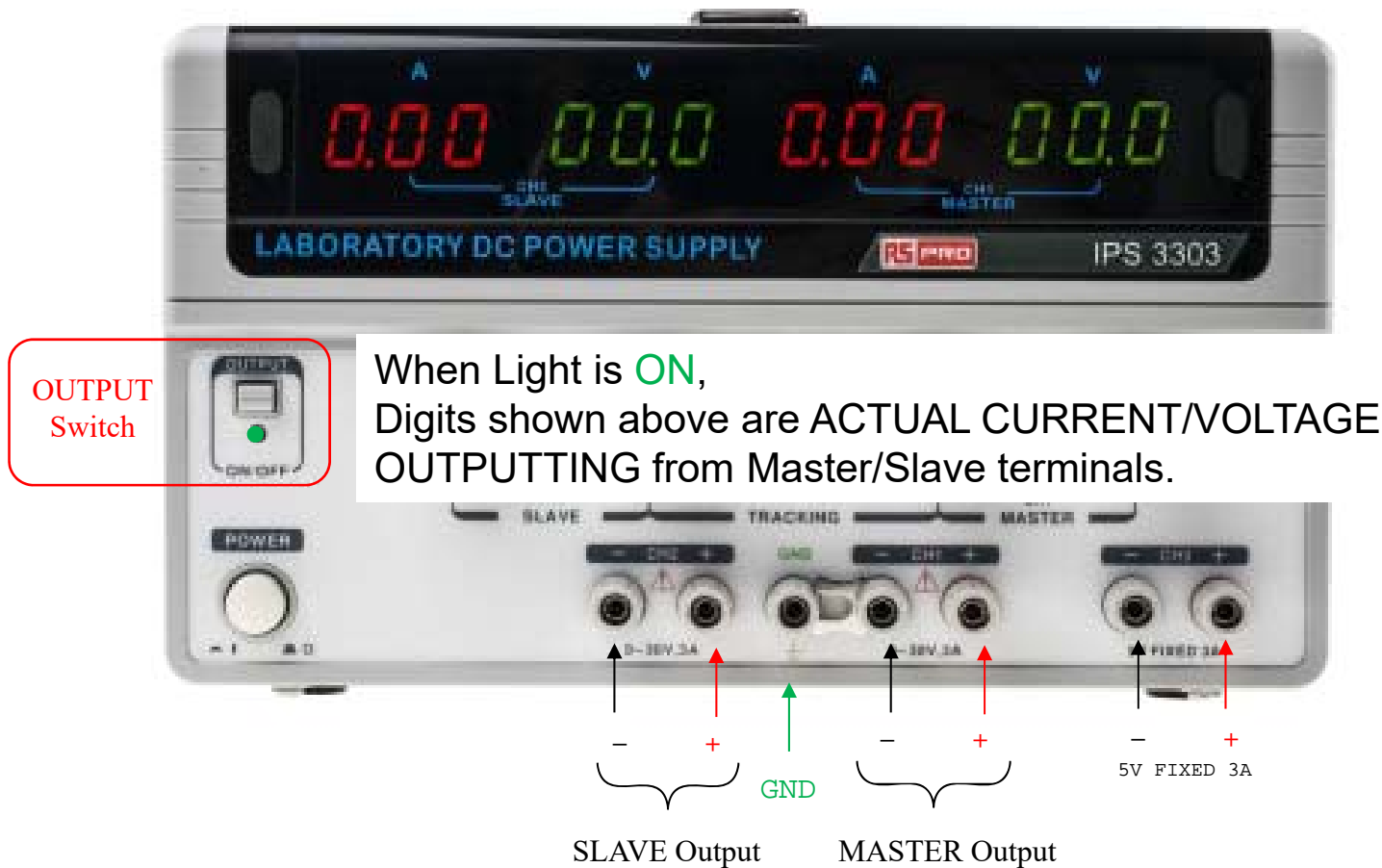
Power Supply – OUTPUT Switch ON

Display for SLAVE

Current Voltage

Display for MASTER

Current Voltage



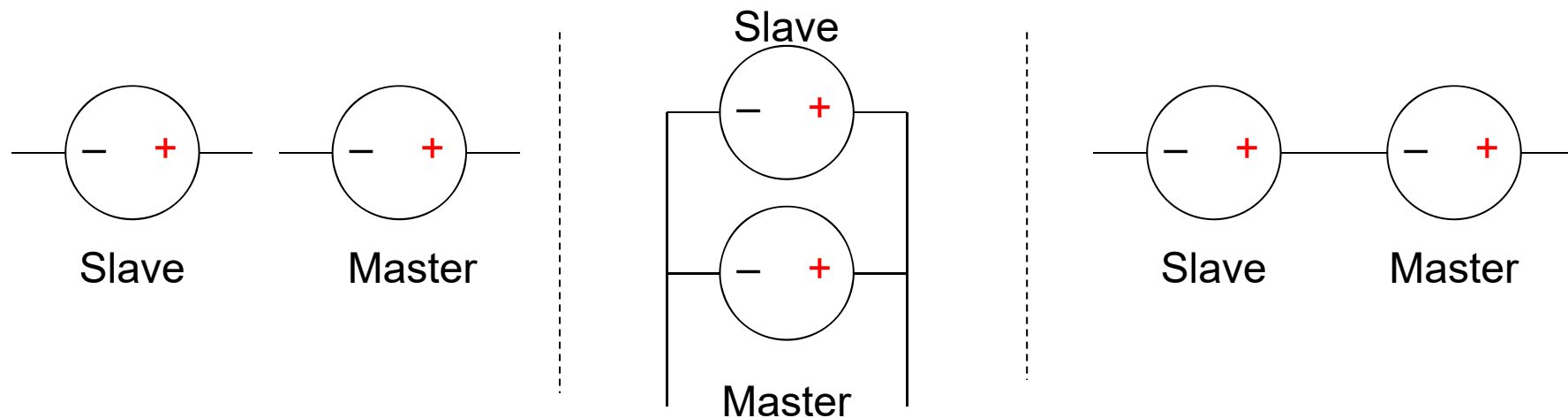
Power Supply

Actually the power supply consists of 3 different supply. Namely Master, Slave, Fixed.

	Max Voltage Output	Max Current Output
MASTER	Adjustable from 0 to 30 Volts	Adjustable from 0 to 3 Amperes
SLAVE	Adjustable from 0 to 30 Volts	Adjustable from 0 to 3 Amperes
FIXED	5 Volts	3 Amperes

Power Supply

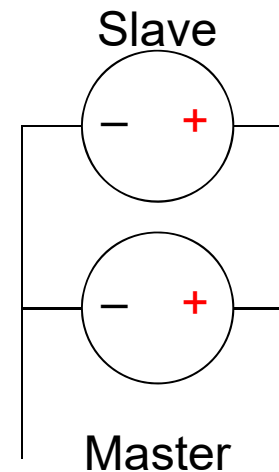
- The Master and Slave Supply can be operated in 3 modes.
 - Independent
 - Series
 - Parallel
- Using your common understanding, what should they mapped to?
- Note that when the power supply is set to series or parallel, the voltage and current will be controlled by master's knob.



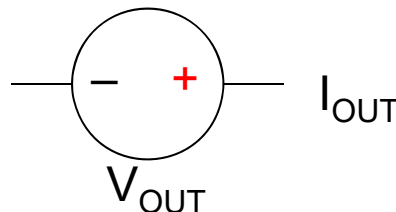
Power Supply

- Using your knowledge from other courses, what is the relationship of Voltage and Current in Parallel ?

- V_M = Voltage of Master
- I_M = Current of Master
- V_S = Voltage of Slave
- I_S = Current of Slave
- V_{OUT} = Voltage of the combined supply in Parallel
- I_{OUT} = Current of the combined supply in Parallel



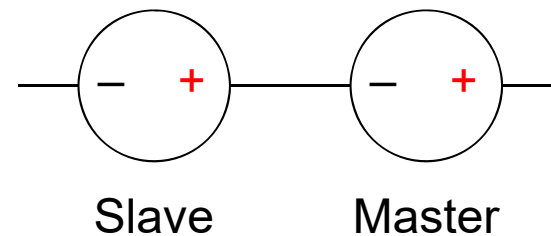
- $V_{OUT} = V_M = V_S$
- $I_{OUT} = I_M + I_S$



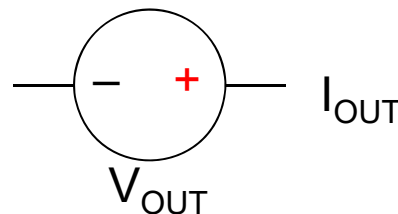
Power Supply

- Using your knowledge from other courses, what is the relationship of Voltage and Current in Series ?

- V_M = Voltage of Master
- I_M = Current of Master
- V_S = Voltage of Slave
- I_S = Current of Slave
- V_{OUT} = Voltage of the combined supply in Series
- I_{OUT} = Current of the combined supply in Series



- $V_{OUT} = V_M + V_S$
- $I_{OUT} = I_M = I_S$



Power Supply (CC and CV)



Constant Voltage : Green
Constant Current : Red

Power Supply (CC and CV)

- The CC and CV light indicate the mode that the power supply is operating.
 - CC – Constant Current Mode
 - CV – Constant Voltage Mode
- Think : What modes should our daily life devices operating at ?
 - Mobile phone, Fan, Light, etc.
- In the LAB, you are required to use the different mode of the Power Supply and also you need to know how to read the current/voltage reading. Hence, you can calculate the power dissipated.

DMM – Measure Current



1. Press SHIFT
2. Press DCI

Question :

In this LAB, all the currents should be less than 0.5A,
so, which terminal to use ?

Should I connect it in Parallel / Series to my circuit ?

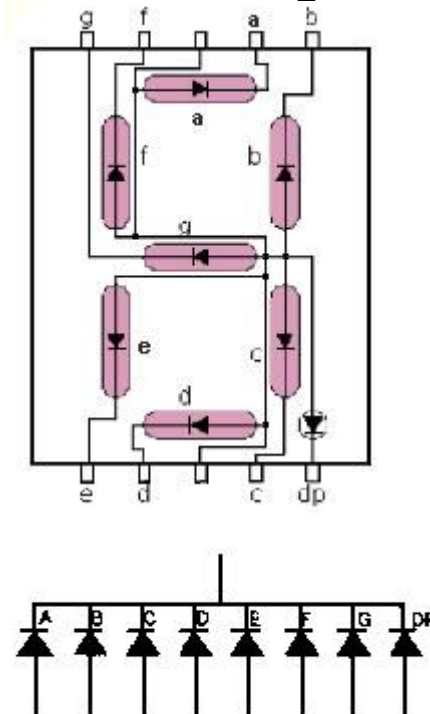
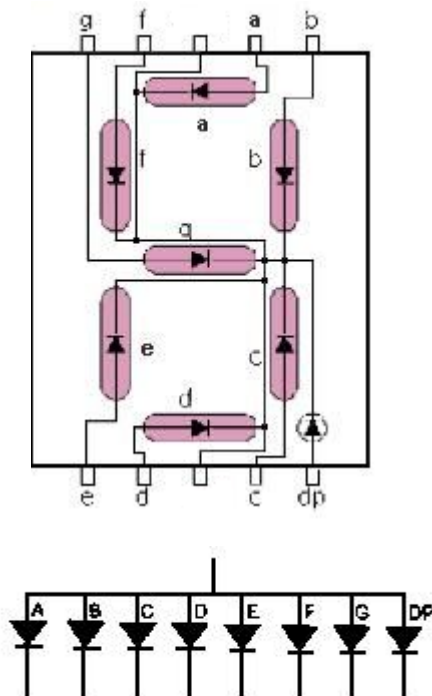


Power Supply

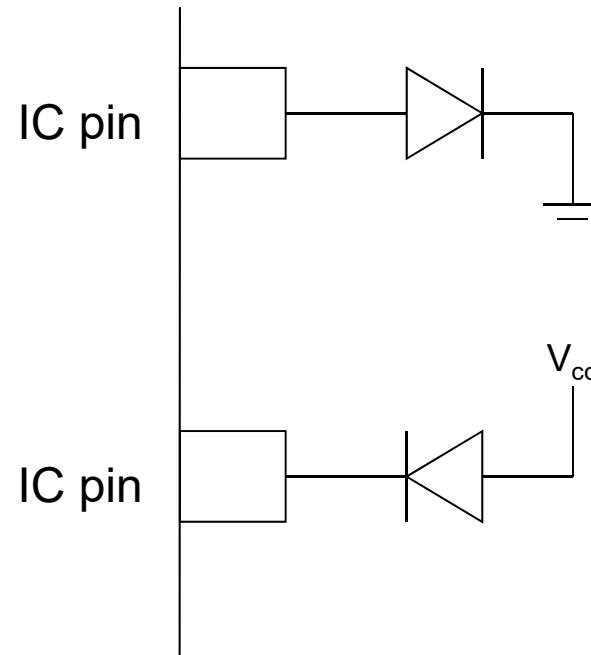
- Will the Power Supply be able to give out the Voltage and Current in the following ? If yes, what mode it should set to ?
 1. 48V 2A
 2. 30V 5A
 3. 4V 1A
 4. 60V 5A
 5. 5V 3A
 6. +/- 10V, 1A

Digital Circuit

- In Digital Circuits and Systems course, you used several 7-segment LED.
- What is the difference between the two configurations?



Digital Circuit



Where is the power of LED comes from ?

Current go in/out from the IC pin ?

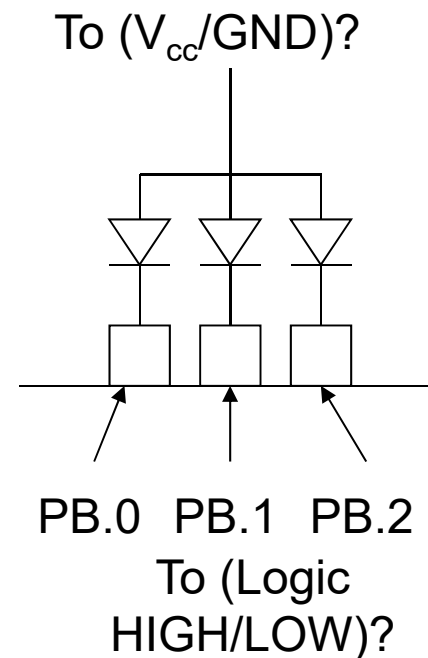
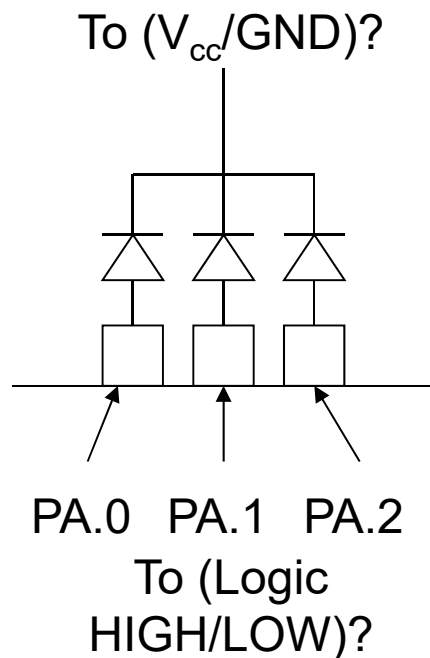
Where is the power of LED comes from ?

Current go in/out from the IC pin ?

- What is the Voltage/Current needed in order to light up a LED to a normal brightness ?

Digital Circuit

- If I want to turn on the LEDs using the configuration setting below
- I should set PA.0, PA.1, PA.2 to ? The common point to ?
- I should set PB.0, PB.1, PB.2 to ? The common point to ?
- What is the difference in intensity ?



Digital Circuit

- From the 74HC04 datasheet

Symbol	Parameter	Rating
V_{CC}	Supply Voltage	–0.5V to +7.0V
V_{IN}	DC Input Voltage	–0.5V to +7.0V
V_{OUT}	DC Output Voltage	–0.5V to $V_{CC} + 0.5V$
I_{IK}	Input Diode Current	–20mA
I_{OK}	Output Diode Current	±20mA
I_{OUT}	DC Output Current	±25mA
I_{CC}	DC V_{CC} /GND Current	±50mA
T_{STG}	Storage Temperature	–65°C to +150°C
T_L	Lead Temperature (Soldering, 10 seconds)	260°C

- **Input Diode Current I_{IK}** – The rated current of the input terminal at which an IC will not suffer breakdown due to latch-up.
- **Output Diode Current I_{OK}** – The rated current of the output terminal at which an IC will not suffer breakdown due to latch-up.
- **Output current I_{OUT}** – The rated current that can flow through one output terminal.

Digital Circuit

- From the 74LS04 datasheet

GUARANTEED OPERATING RANGES

Symbol	Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	54 74	4.5 4.75	5.0 5.0	5.5 5.25	V
T_A	Operating Ambient Temperature Range	54 74	-55 0	25 25	125 70	°C
I_{OH}	Output Current — High	54, 74			-0.4	mA
I_{OL}	Output Current — Low	54 74			4.0 8.0	mA

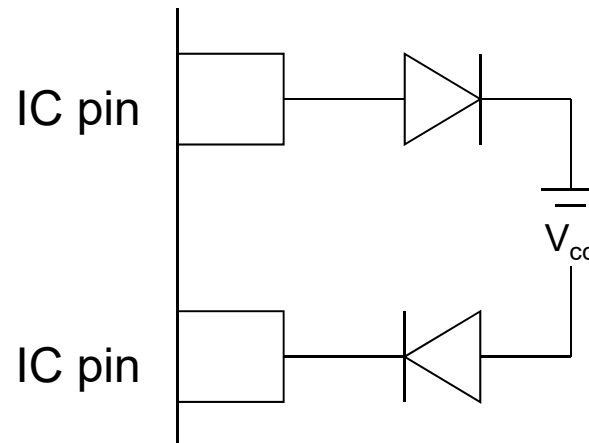
- I_{OH} **Output HIGH current.** The leakage current flowing into a turned off open collector output with a specified HIGH output voltage applied. For devices with a pull-up circuit, the I_{OH} is the current flowing out of an output which is in the HIGH state.
- I_{OL} **Output LOW current** — The current flowing into an output which is in the LOW state.

Digital Circuit

- From the 74LS04 datasheet

GUARANTEED OPERATING RANGES

Symbol	Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	54 74	4.5 4.75	5.0 5.0	5.5 5.25	V
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I_{OL}	Output Current — Low	54 74			4.0 8.0	mA



How much current can the IC pin provide ?

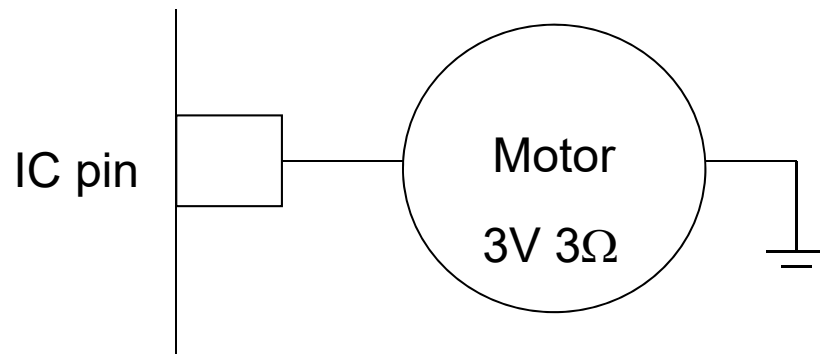
How much current can go into the IC pin ?

Digital Circuit

- A common misunderstanding.....
 - ❑ Most of the student would think that each pin of a microcontroller/IC can give out a power like a power supply !!
- In task 2 of the LAB, you are required to use the Digital Multi-meter to measure the output from the IC and the power supply.
- Please pay attention to the following
 - ❑ What is the maximum power that can give out by the power supply
 - ❑ What is the maximum power that can give out by the IC
 - ❑ What is the maximum power that can sink by the IC

Transistor

- In Electronic Circuit course, you learnt transistor. The role of transistor can be used for amplifier and also as a switch.
- If you forgot all the things in Electronic Circuits, please go back to revise a bit 😊



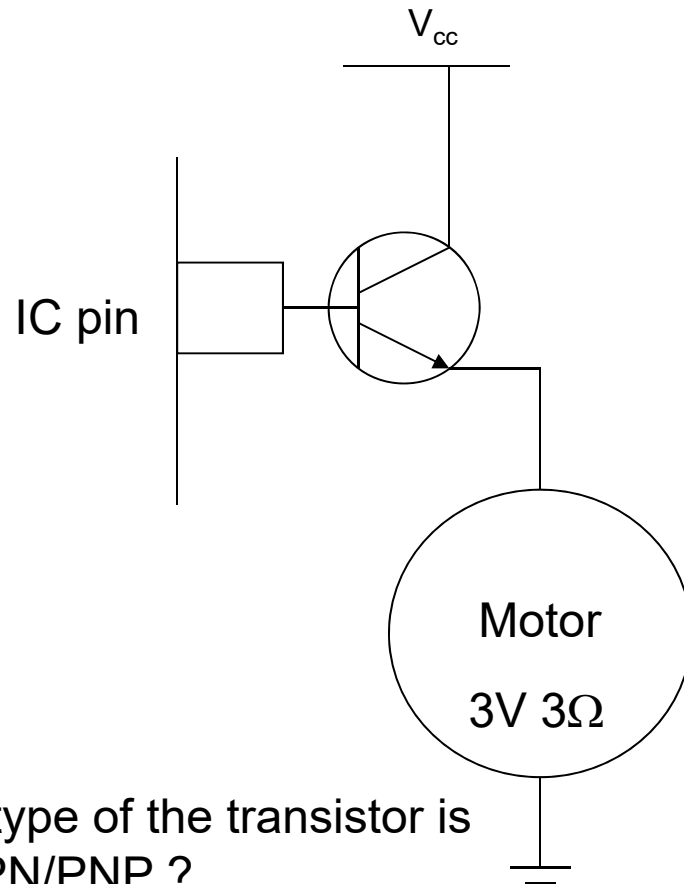
If IC pin is Logic HIGH

Will the motor turn ?

Why ?

Can I modify the circuit
to make the motor turn ?

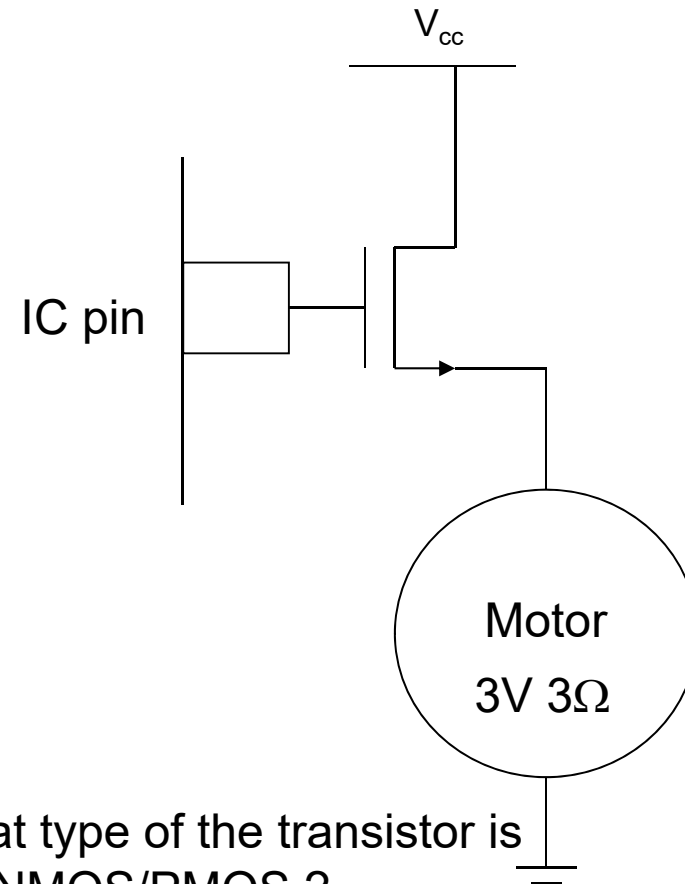
Transistor



What type of the transistor is it ? NPN/PNP ?

If IC pin is at Logic HIGH

Will the motor turn ? Why ?





What type of the transistor is it ? NMOS/PMOS ?

If IC pin is at Logic HIGH

Will the motor turn ? Why ?

IMPORTANT Notes for ALL LABS

- ALL the LABs should require more than 2-hour for you to finish, that includes your pre-lab study, hardware and coding (for later LABs).
- To facilitate your preparation for LAB2 to LAB6, **you will be able to borrow the development board at your LAB1**. You will then be able to prepare or complete the LAB2 to LAB6 at home BEFORE your LAB session.
- As a result, the 2-hour LAB session for LAB2 to LAB6 is **only for you to DEMO**.
- To encourage all of you finish your LAB early
 - ▣ 1 point bonus out of 10 points for each LAB will be given for those who finish their DEMO **within 1.5 hour after the start of each session**. 
- The LAB sessions will **END SHARP at 2 hours AFTER the scheduled time** for each session.
- Please prepare your LAB early. 



END