ELEC 3300 – Tutorial for LAB1

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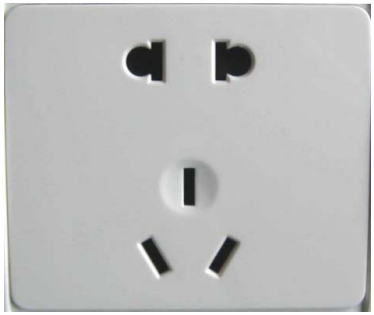
About LAB 1

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

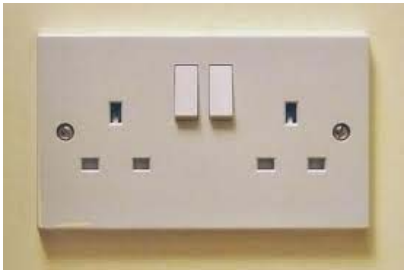
Power Supply



- What is a Power Supply ?
- A Power Supply should give out ?
- Power = I^2R, $\frac{V^2}{R}$, $\frac{P}{t}$, VI
- For HK Socket
  - Do you know the Voltage ?
  - Do you know the Current ?

220 V AC
50 Hz

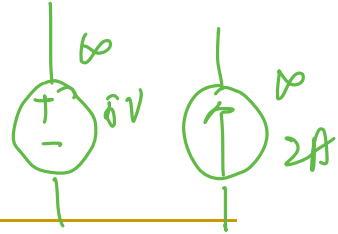
13A max



Power Supply

- Are they called power supply ?

$R = \frac{V}{I}$



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

voltage source / current source

voltage is constant eg (5 volts)

current is constant eg (3A) theoretical current that come

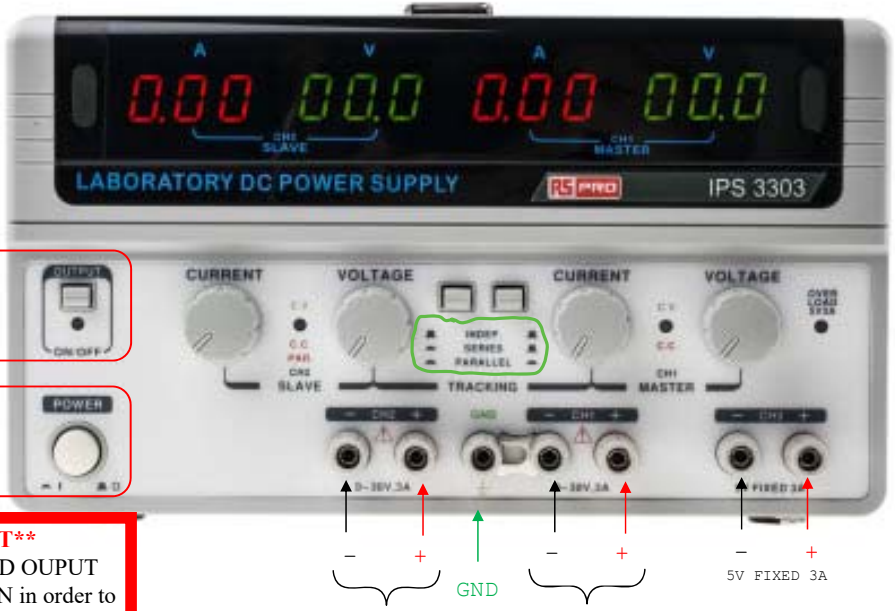
through voltage source = 0

theoretical voltage ....
current source = ∞

Power Supply

Display for SLAVE
Current Voltage

Display for MASTER
Current Voltage



A power supply consists of 3 power supply

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

Max Power output

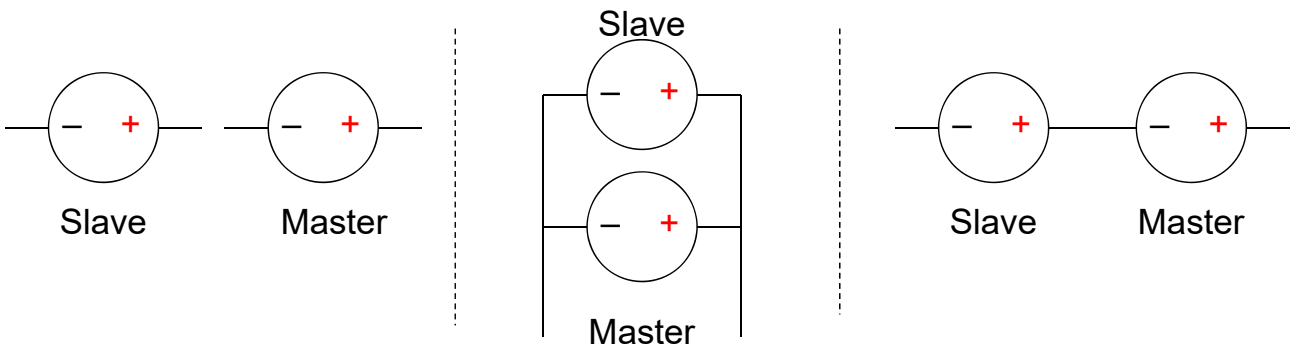
30 x 3 = 90w

30 x 3 = 90w

5 x 3 = 15w

Power Supply

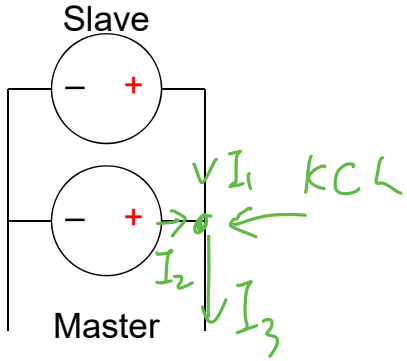
- The Master and Slave Supply can be operated in 3 modes.
  - Independent
  - Series
  - Parallel
- Using your common understanding, what should they mapped to?
- Note that when the power supply is set to series or parallel, the voltage and current will be controlled by master's knob.



independent parallel series

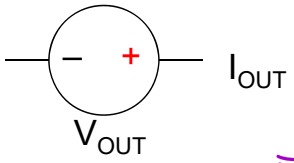
Power Supply

- 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



Kirchoff's voltage law

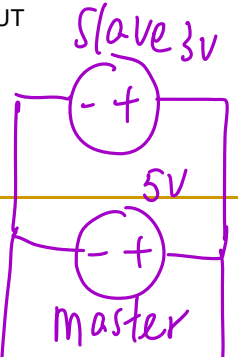
- $V_{OUT} = V_M = V_S$
- $I_{OUT} = I_M + I_S$



$I_1 + I_2 = I_3$

Example : powerbank

: Connect battery in parallel

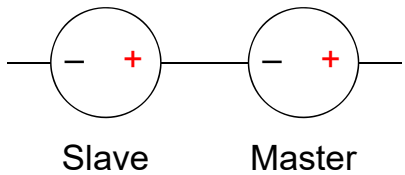


what happens?

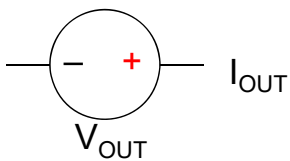
master charges

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)

only in 1 operation mode at a time

displaying instantaneous voltage & current

$R = \frac{V}{I}$

adjust max voltage & current

$I = \frac{10}{100}$

$I = 0.1A$

$V = IR$

$= (0.1)(100)$

$= 10V$

eg max 10V
1A

Constant Voltage : Green
Constant Current : Red

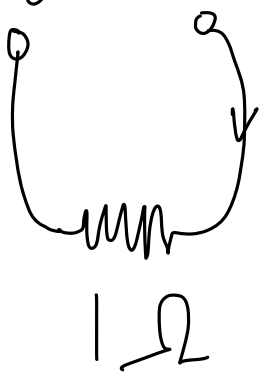
100Ω

most devices : constant voltage mode

Question : voltage across resistor? 10 10V

current across resistor? 0.1A

Constant current



1A

1Ω

10V max

$V = IR$

$= (1)(1)$

$= 1V$

$R = \frac{V}{I}$

Theoretically

$I = \frac{10V}{1\Omega}$

$= 10A$

But power supply max give out 1A.

voltage across resistor = 1V

current across resistor = 1A

0Ω

10 Volts

1A

$R = \frac{V}{I}$

10 volts 0 ampere

0 volts 1 ampere

Do you think any current flow through resistor? Ans: No.

0 volts 1 ampere ⟸ very contradicting

no potential difference, how can there be current flowing through resistor

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.

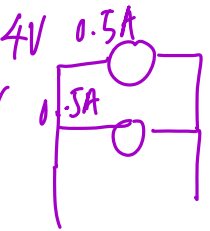
- In the LAB, you are required to use the different mode of the Power Supply and also you need to know how to read the current/voltage reading. Hence, you can calculate the power dissipated.

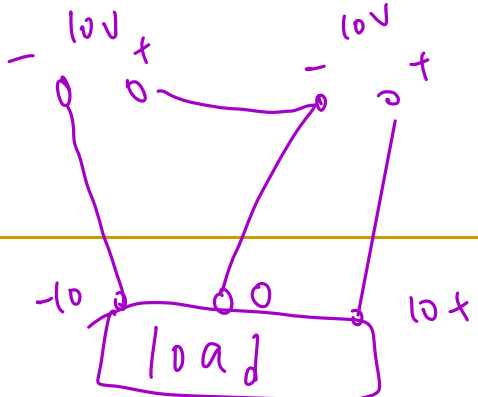
Power Supply

- 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

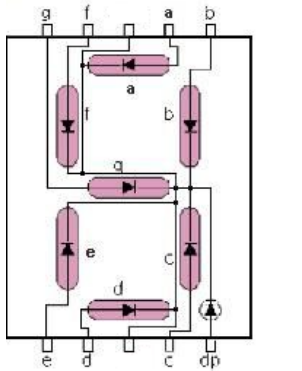
Series
parallel
independent series / parallel
30V 5A / 60V 3A
series / parallel / independent



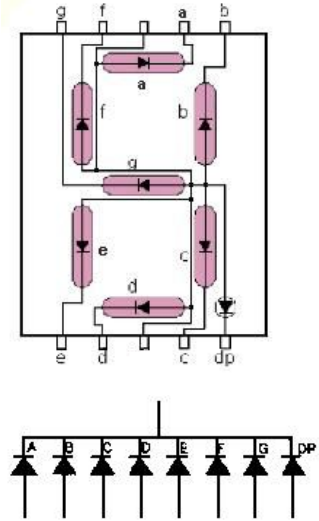


Digital Circuit

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

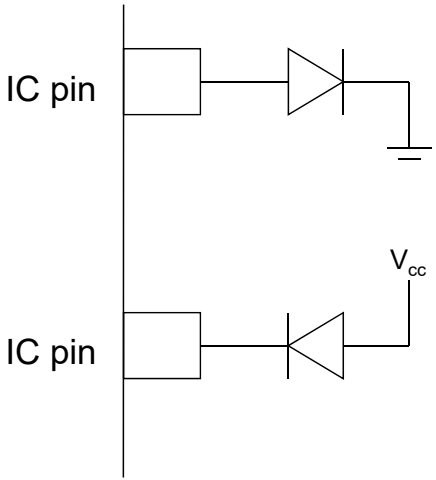


Common anode



common cathode

Digital Circuit



Where is the power of LED comes from ?

Current go in/out from the IC pin ?

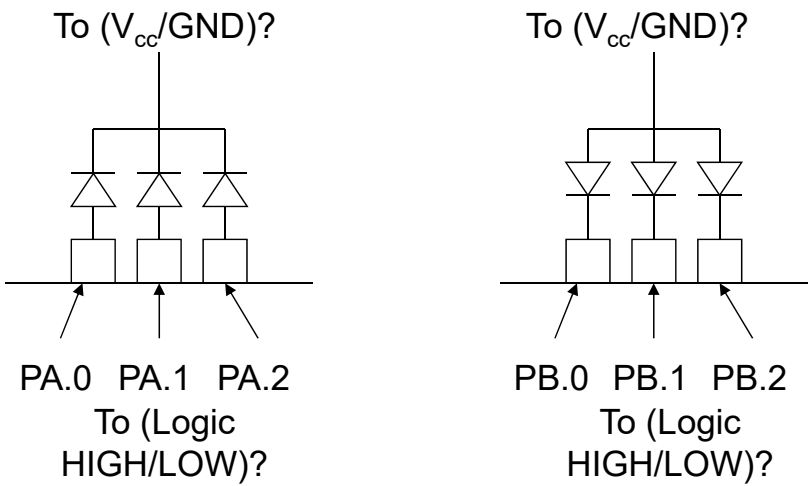
Where is the power of LED comes from ?

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.

IC PIN IS NOT a power supply.

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

flowing out

4 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
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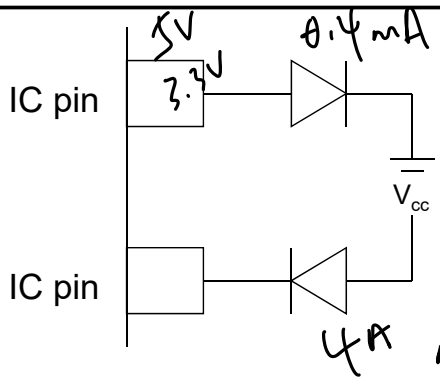


How much current can the IC pin provide ?

How much current can go into the IC pin ?

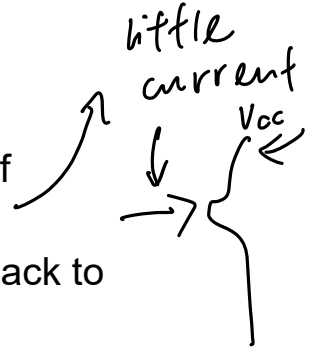
Digital Circuit

- 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 !!

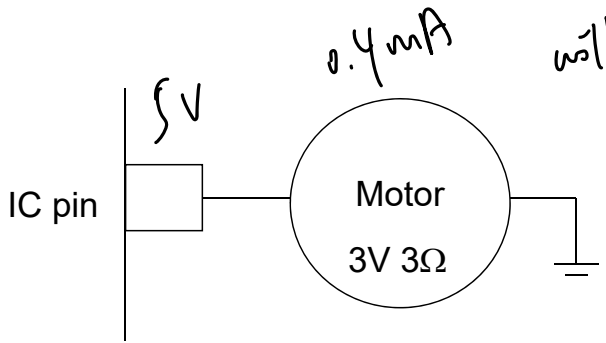
- In task 2 of the LAB, you are required to use the Digital Multi-meter to measure the output from the IC and the power supply.

- 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 ☺



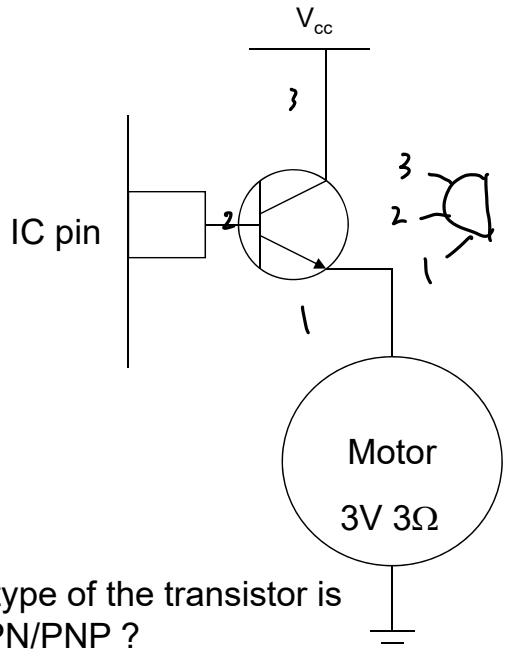
If IC pin is Logic HIGH

Will the motor turn ?
Why ?

Can I modify the circuit to make the motor turn ?

IC pin cannot drive a motor !

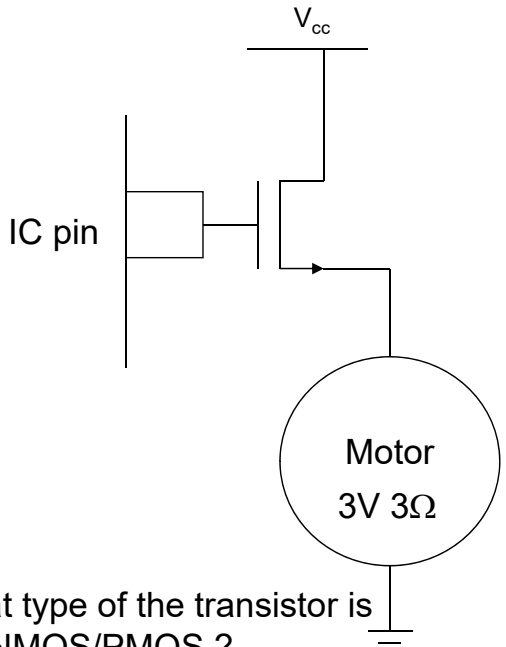
Transistor



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