



EIA Workshop I

Electronic Circuits (電子線路)

Professor Alex Leung

Battery(電池)



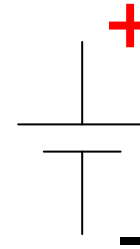
AAA
Battery



AA
Battery

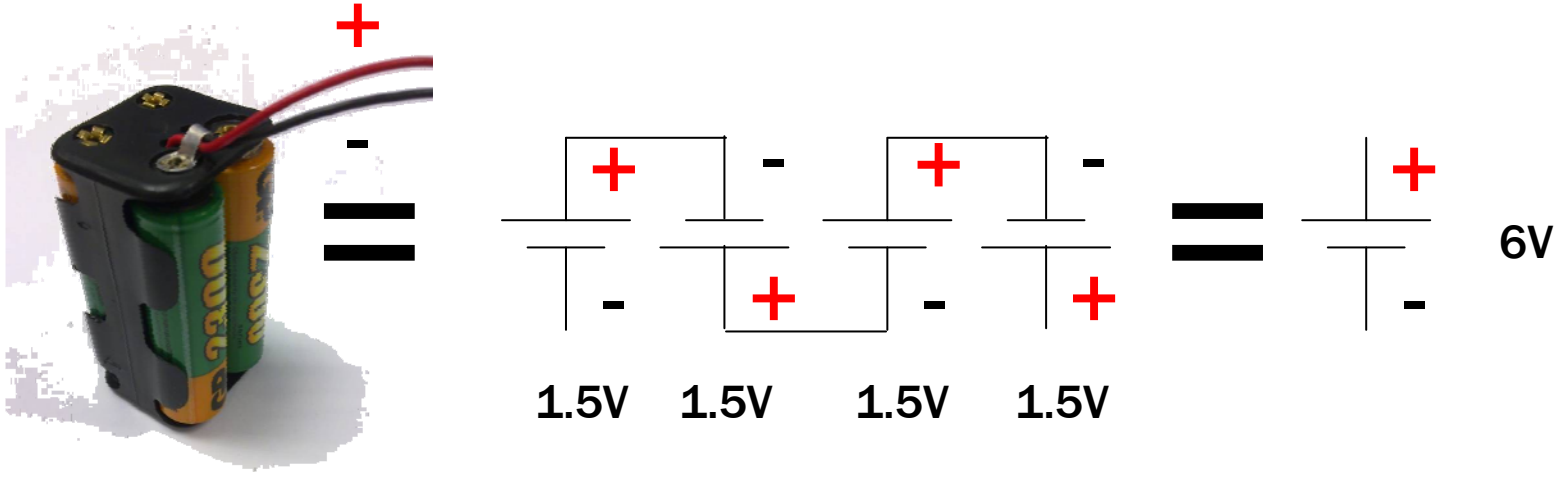
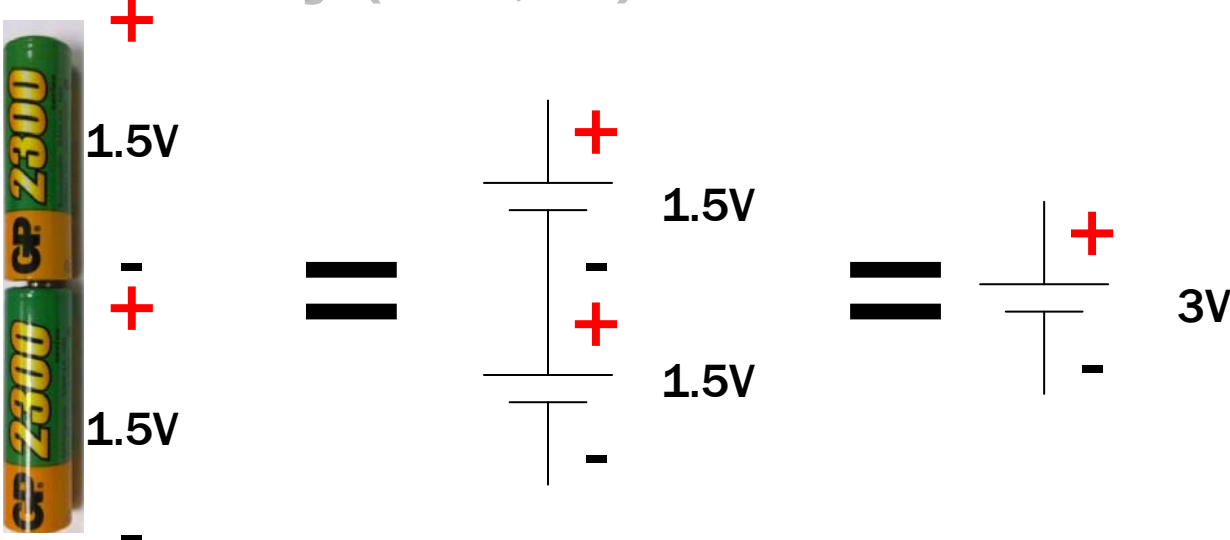


9V
Battery

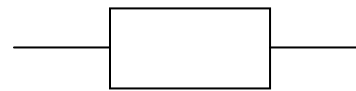
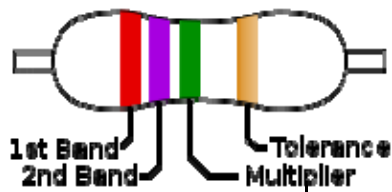


Battery Symbol
(電池符號)

Battery(電池)



Resistor (電阻)



Resistor Symbol
(電阻的符號)

Example 1:



Brown	Black	Orange	Gold
1	0	$\times 10^3$	$\pm 5\%$

$$10 \times 10^3 = 10\,000 \, \Omega$$



Brown	Black	Green	Gold
1	0	$\times 10^5$	$\pm 5\%$

$$10 \times 10^5 = 10\,00000 \, \Omega$$

Color	Significant figures	Multiplier	Tolerance	Temp. Coefficient (ppm/K)		
Black	0	$\times 10^0$	–	250	U	
Brown	1	$\times 10^1$	$\pm 1\%$	F	100	S
Red	2	$\times 10^2$	$\pm 2\%$	G	50	R
Orange	3	$\times 10^3$	–	15	P	
Yellow	4	$\times 10^4$	–	25	Q	
Green	5	$\times 10^5$	$\pm 0.5\%$	D	20	Z
Blue	6	$\times 10^6$	$\pm 0.25\%$	C	10	Z
Violet	7	$\times 10^7$	$\pm 0.1\%$	B	5	M
Gray	8	$\times 10^8$	$\pm 0.05\%$	A	1	K
White	9	$\times 10^9$	–	–	–	
Gold	–	$\times 10^{-1}$	$\pm 5\%$	J	–	
Silver	–	$\times 10^{-2}$	$\pm 10\%$	K	–	
None	–	–	$\pm 20\%$	M	–	

System of Unit(SI) (單位系統)

Name	deca-	hecto-	kilo-	mega-	giga-	tera-	peta-
Symbol	da	h	k	M	G	T	P
Factor	10^1	10^2	10^3	10^6	10^9	10^{12}	10^{15}

Name	deci-	centi-	milli-	micro-	nano-	pico-	femto-
Symbol	d	c	m	μ	n	p	f
Factor	10^{-1}	10^{-2}	10^{-3}	10^{-6}	10^{-9}	10^{-12}	10^{-15}

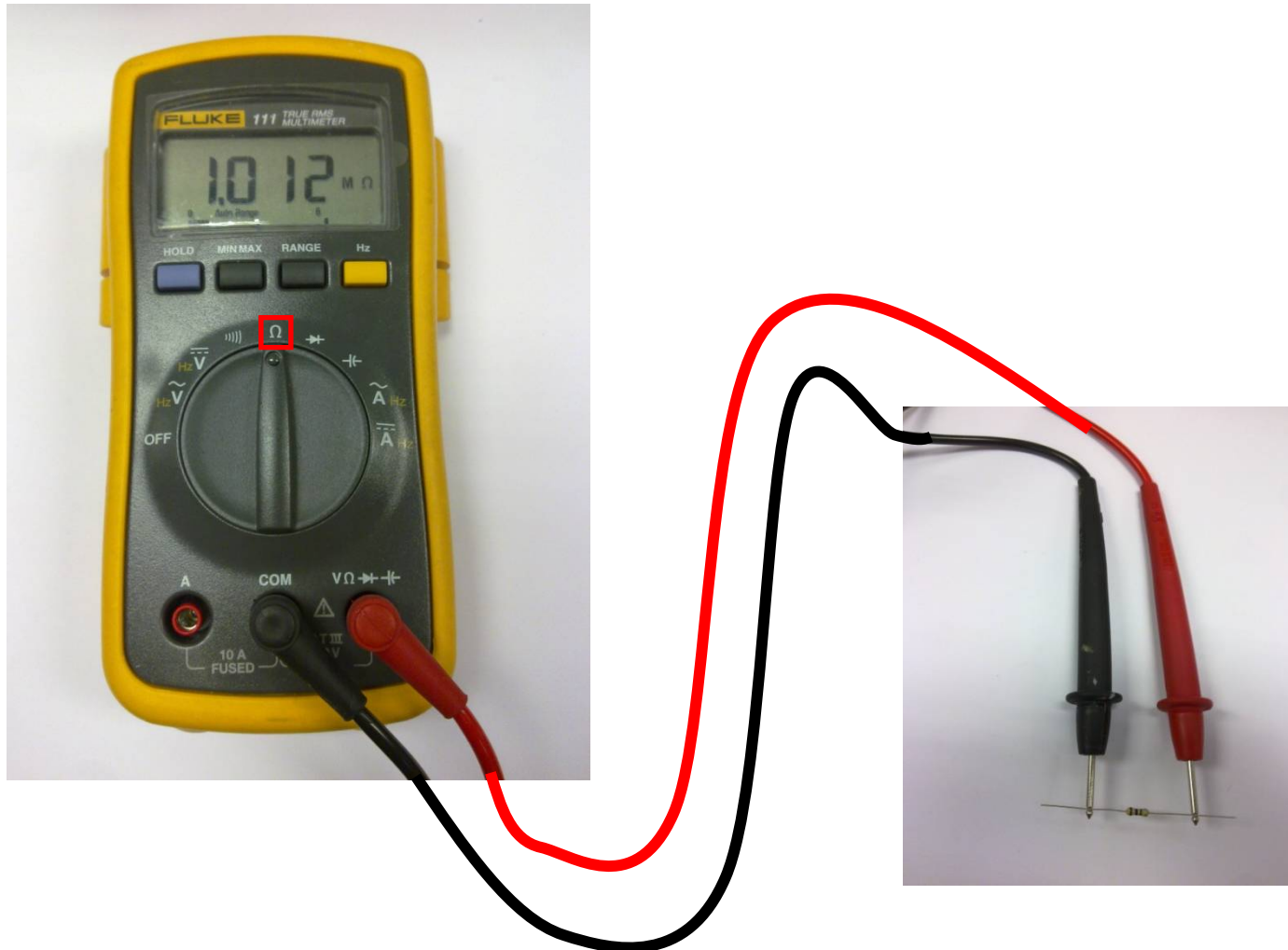
For example one:

$$10 \times 10^3 = 10\,000 \, \Omega = 10\text{k} \, \Omega$$

For example two:

$$10 \times 10^5 = 1\,000\,000 \, \Omega = 1\text{M} \, \Omega$$

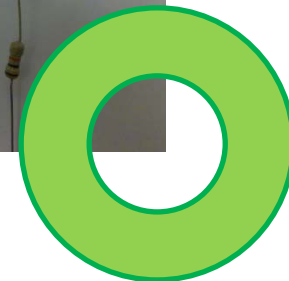
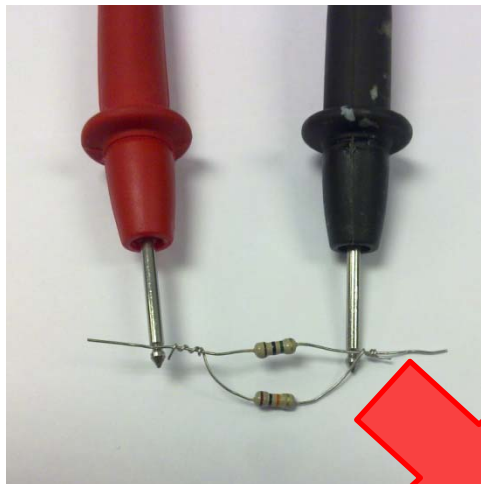
Multi-meter (萬用電錶)



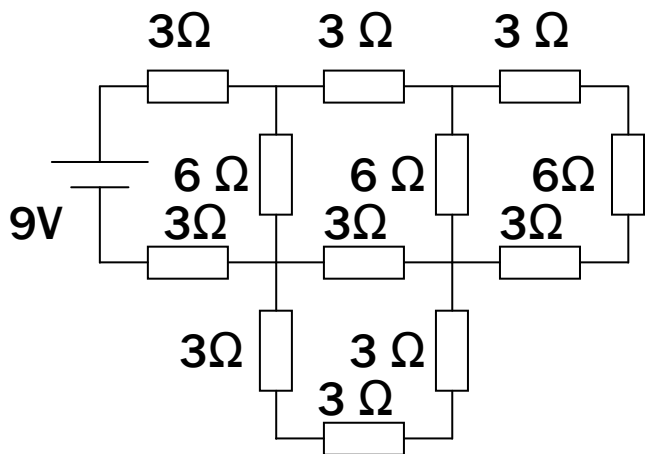
Multi-meter (萬用電錶)

We would like to measure the value of $1\text{M}\ \Omega$ resistor

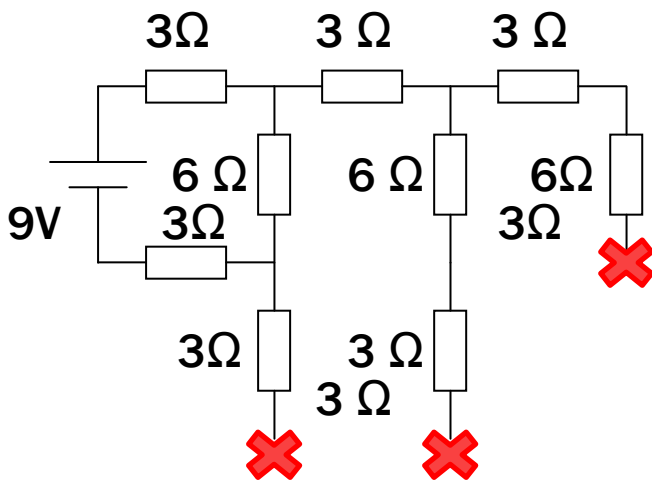
當我們量度 $1\text{M}\ \Omega$ 電阻的時候



Complete Circuit(完整線路)

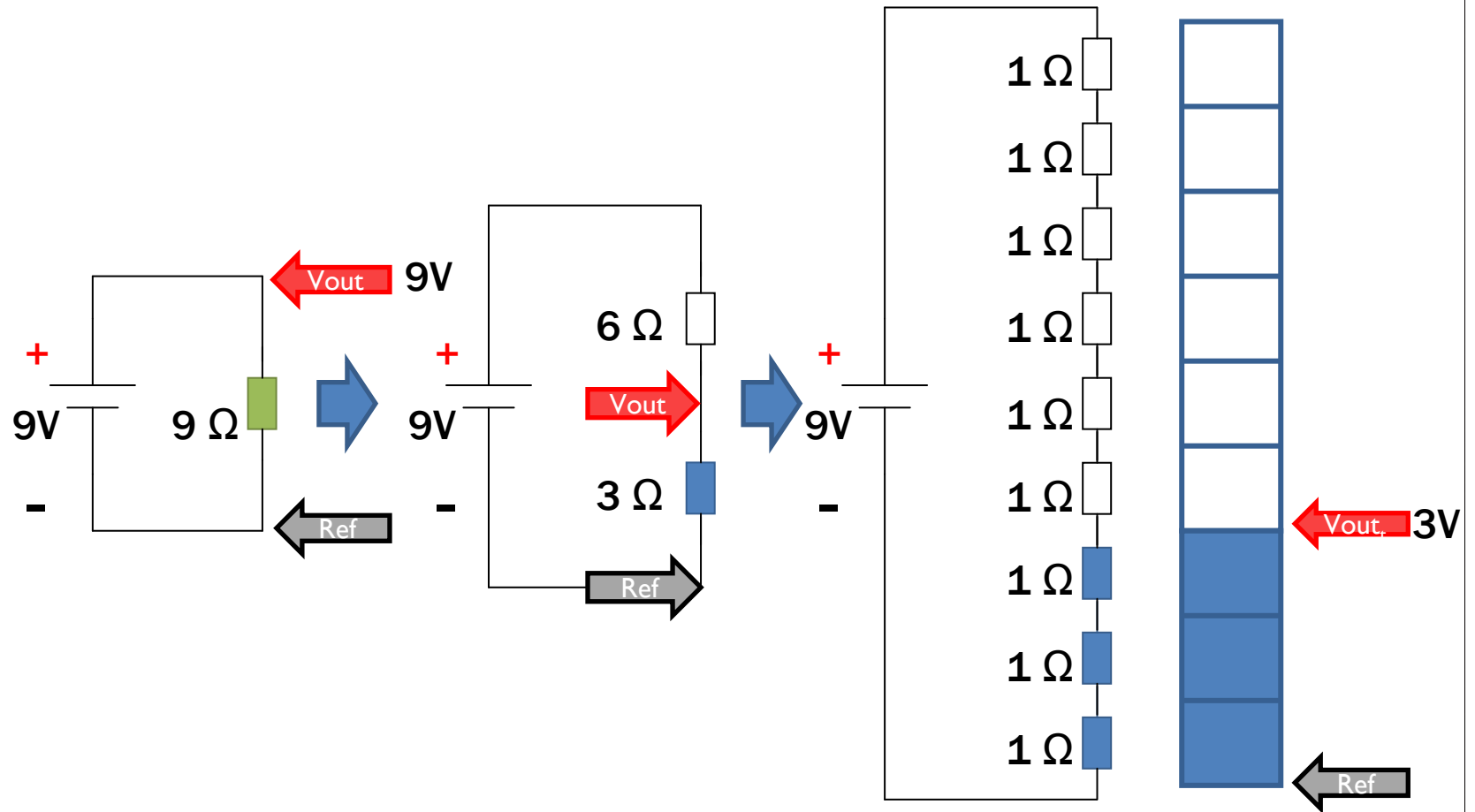


Complete Circuit
(完整線路)

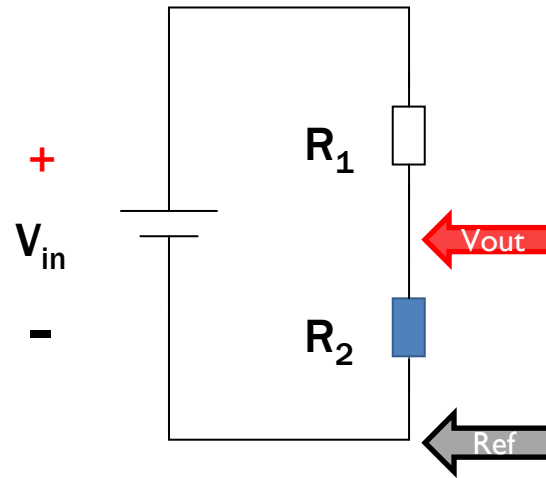


Incomplete Circuit
(非完整線路)

Potential Divider (電壓分配)

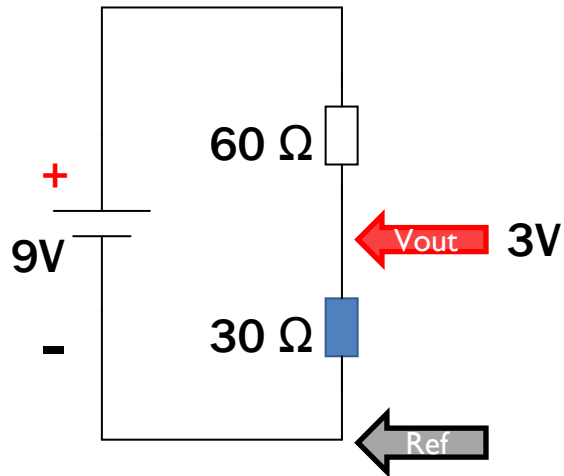


Potential Divider (電壓分配)

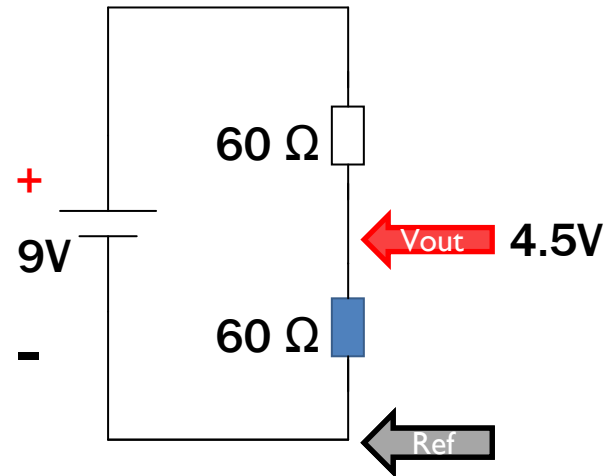


$$V_{out} = \frac{R_{out}}{R_{total}} \cdot V_{in} = \frac{R_2}{R_1 + R_2} \cdot V_{in}$$

Potential Divider (電壓分配)

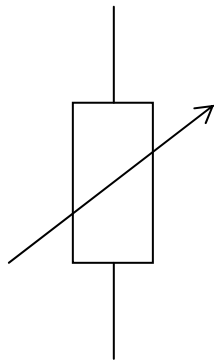
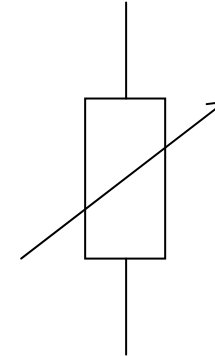


$$\begin{aligned} V_{out} &= \frac{R_{out}}{R_{total}} \cdot V_{in} = \frac{R_2}{R_1 + R_2} \cdot V_{in} \\ &= \frac{30\Omega}{30\Omega + 60\Omega} \cdot 9V \\ &= 3V \end{aligned}$$



$$\begin{aligned} V_{out} &= \frac{R_{out}}{R_{total}} \cdot V_{in} = \frac{R_2}{R_1 + R_2} \cdot V_{in} \\ &= \frac{60\Omega}{60\Omega + 60\Omega} \cdot 9V \\ &= 4.5V \end{aligned}$$

Sensor (感應器)



For example:

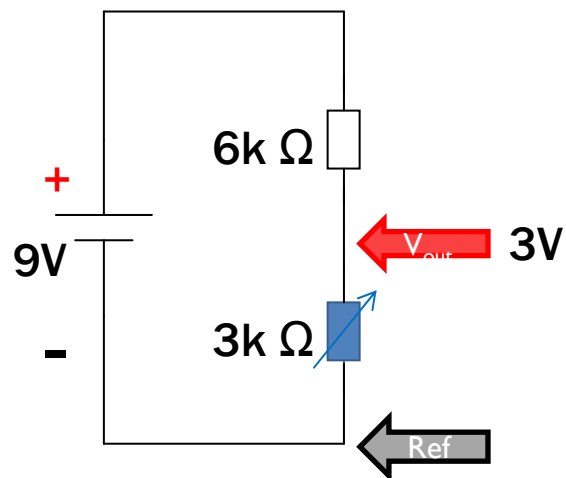
Strong light condition $R=3000 \Omega$
在強光之下時

In dark environment $R=6000 \Omega$
環境黑暗時

Sensor (感應器)

Strong light environment

強光之下



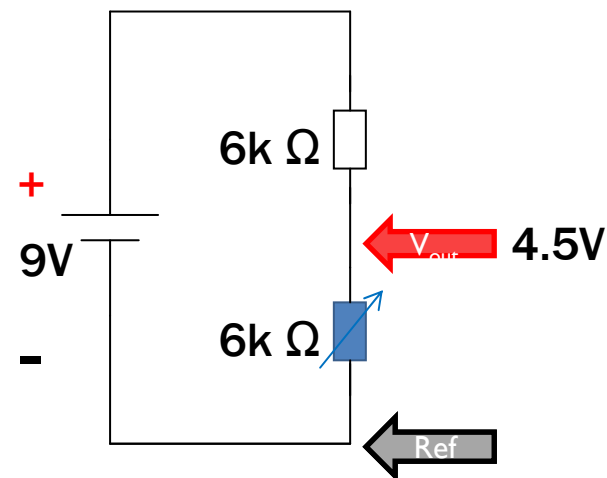
$$V_{out} = \frac{R_{out}}{R_{total}} \cdot V_{in} = \frac{R_2}{R_1 + R_2} \cdot V_{in}$$

$$= \frac{3k\Omega}{3k\Omega + 6k\Omega} \cdot 9V$$

$$= 3V$$

Dark environment

黑暗環境



$$V_{out} = \frac{R_{out}}{R_{total}} \cdot V_{in} = \frac{R_2}{R_1 + R_2} \cdot V_{in}$$

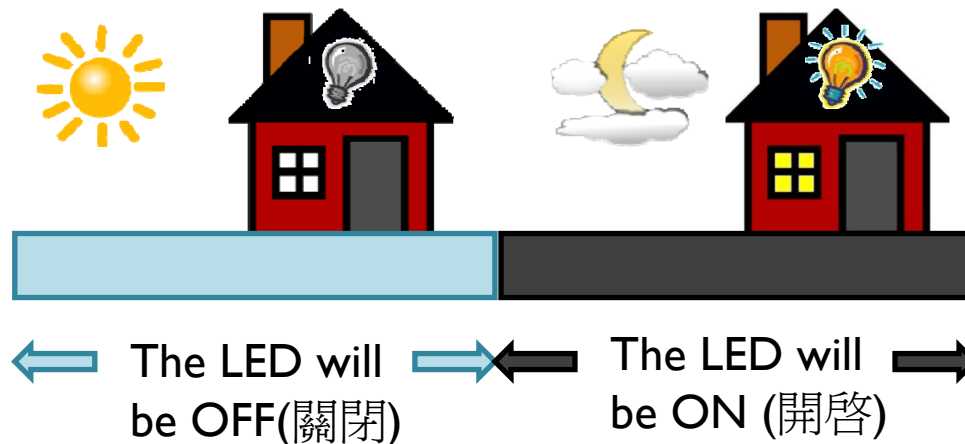
$$= \frac{6k\Omega}{6k\Omega + 6k\Omega} \cdot 9V$$

$$= 4.5V$$

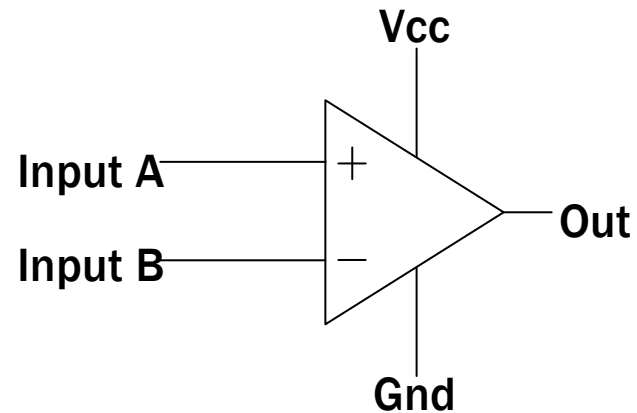
Sensor (感應器)

Design a system that will light up in the dark environment
設計一個於環境黑暗時會照明的系統

Strong light environment 強光之下	R=3000 Ω
Dim light environment 弱光之下 (黃昏、黎明)	R=4000 Ω
Dark environment 黑暗環境	R=6000 Ω

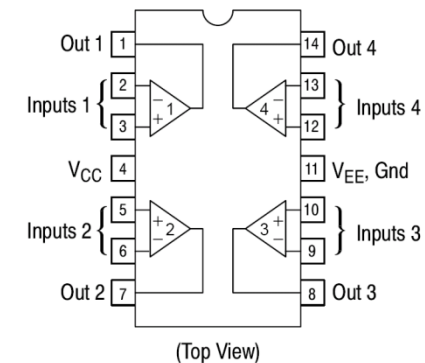


Comparator (比較器)



連接方法

PIN CONNECTIONS



Model: LM 324

Vcc: Connect to the highest voltage point in the circuit (連接到線路的電壓最高點)

Gnd: Connect to the lowest voltage point in the circuit (連接到線路的電壓最低點)

Input A > Input B

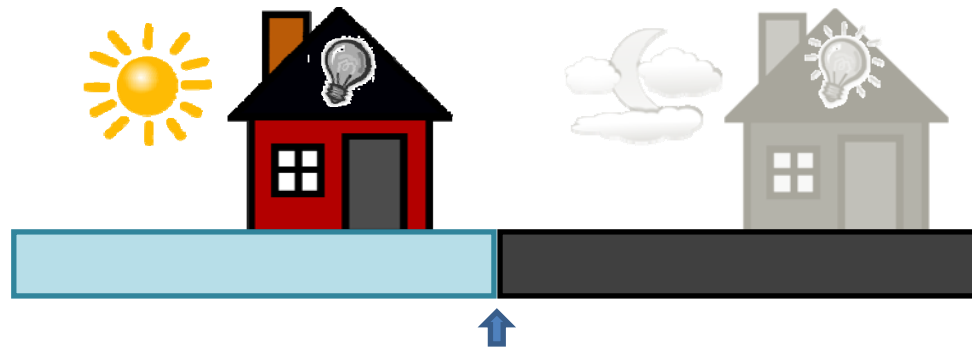
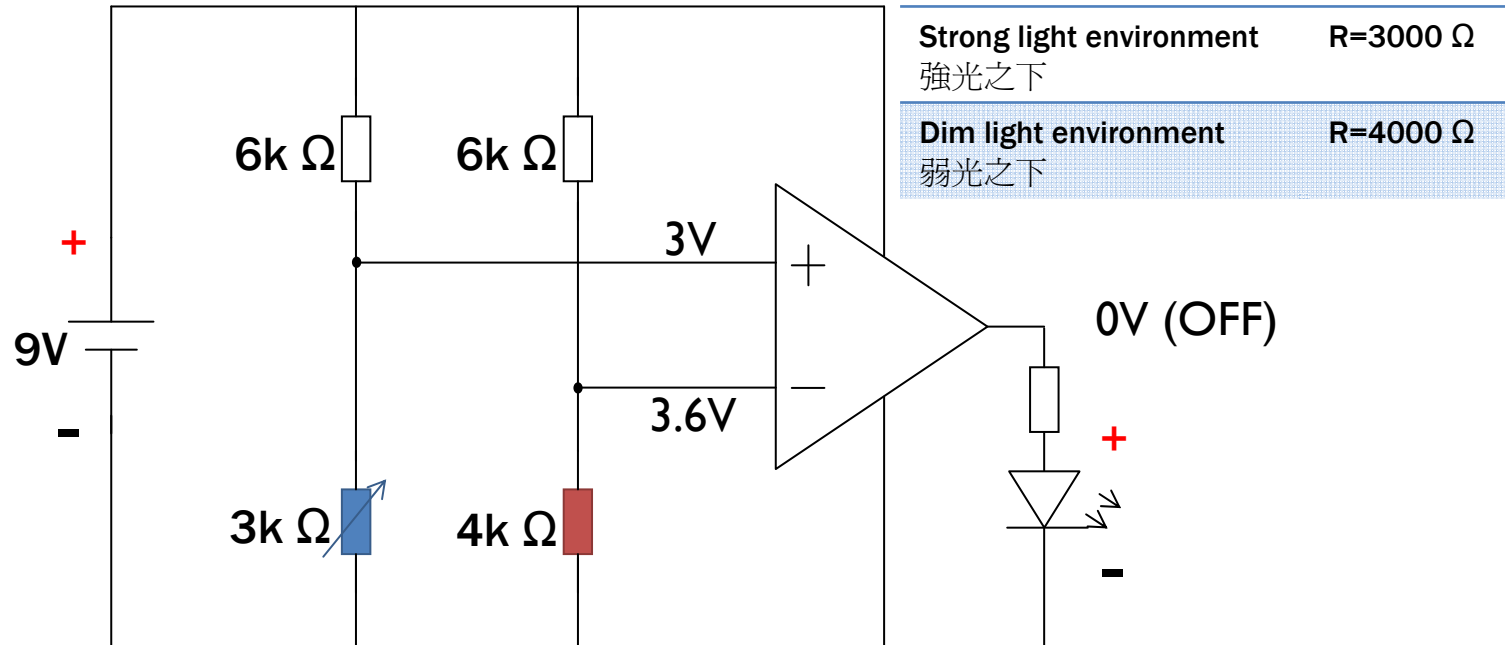
Out = Vcc

Input B > Input A

Out = Gnd

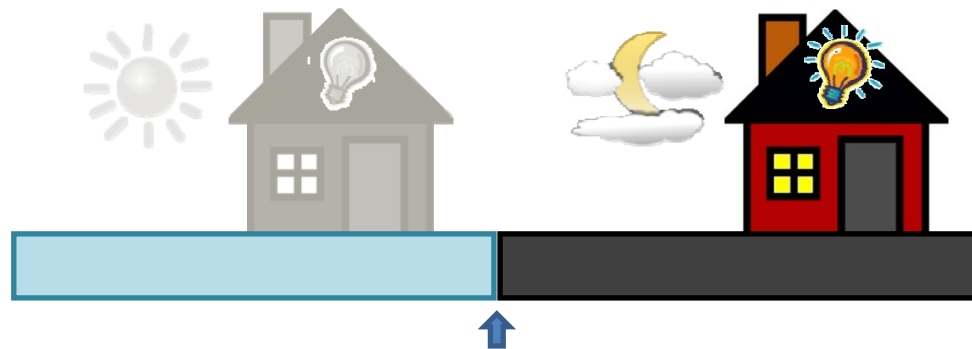
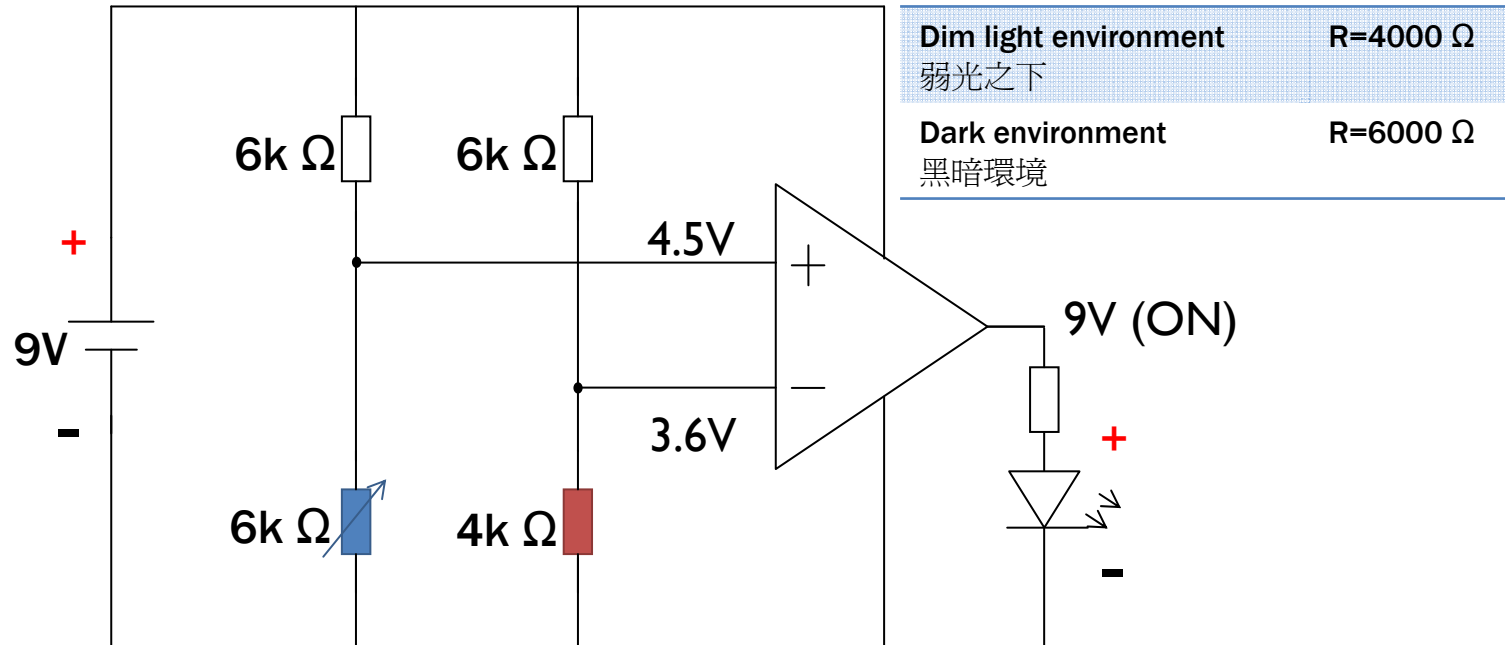
Reference Website: <http://pdf1.alldatasheet.com/datasheet-pdf/view/11666/ONSEMI/LM324.html>

Comparator (比較器)



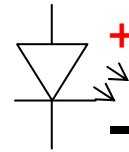
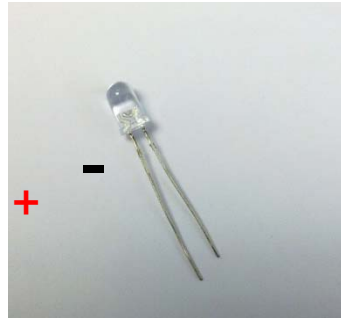
與此點比較，如黃昏及黎明時

Comparator (比較器)



與此點比較，如黃昏及黎明時

LED(發光二極管)



LED symbol
發光二極管的符號

Maximum Rating: (最大功率)

Parameter (參數)	Symbol (符號)	Rating (功率)	Unit(單位)
Forward Current(順向電流)	IF	30	mA

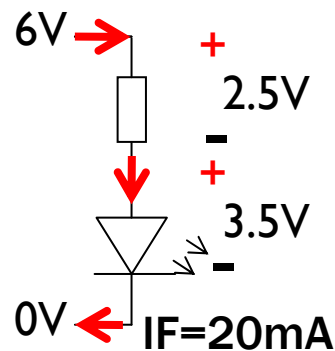
Typical condition (典型情況):

Parameter(參數)	Typ. (典型)	Condition (情況)
Forward Voltage(順向電壓)	3.5 V	IF= 20 mA

Reference website: <http://pdf1.alldatasheet.com/datasheet-pdf/view/103726/ETC/383-2UBC.html>

LED(發光二極管)

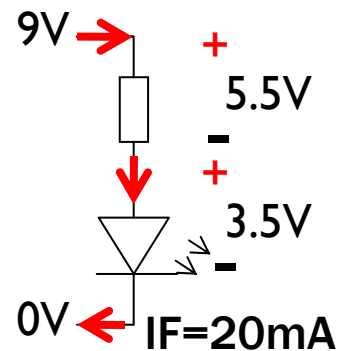
Parameter(參數)	Typ. (典型)	Condition (情況)
Forward Voltage (順向電壓)	3.5	IF= 20 mA



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

$$= \frac{2.5V}{20mA} = \frac{2.5V}{0.02A}$$

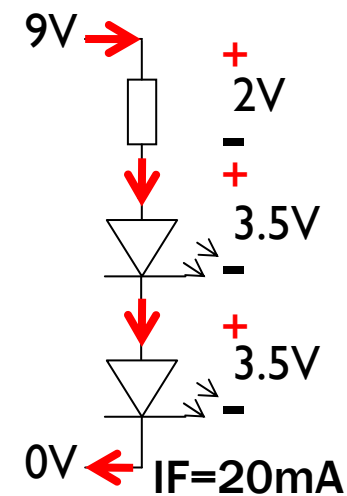
$$= 125\Omega$$



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

$$= \frac{5.5V}{20mA} = \frac{5.5V}{0.02A}$$

$$= 275\Omega$$



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

$$= \frac{2V}{20mA} = \frac{2V}{0.02A}$$

$$= 100\Omega$$



End