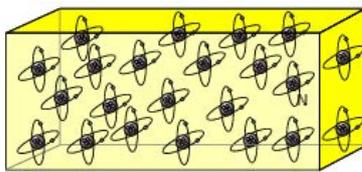


Basic Elements of Electricity

Jee-Hwan Ryu

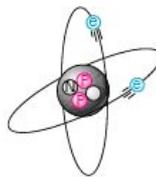
School of Mechanical Engineering
Korea University of Technology and Education

물질의 구조



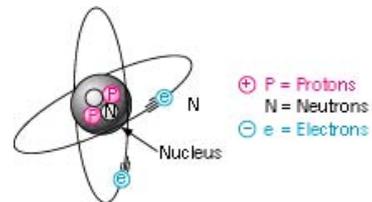
(a)

(a) 원소: 여러 유사 원자

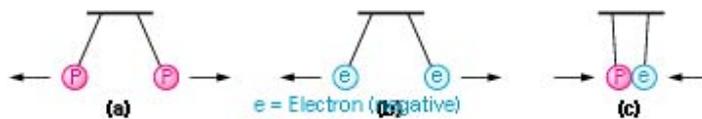


(b)

(b) 원자: 최소단위



Protons: 양자
Neutrons: 중성자
Electrons: 전자

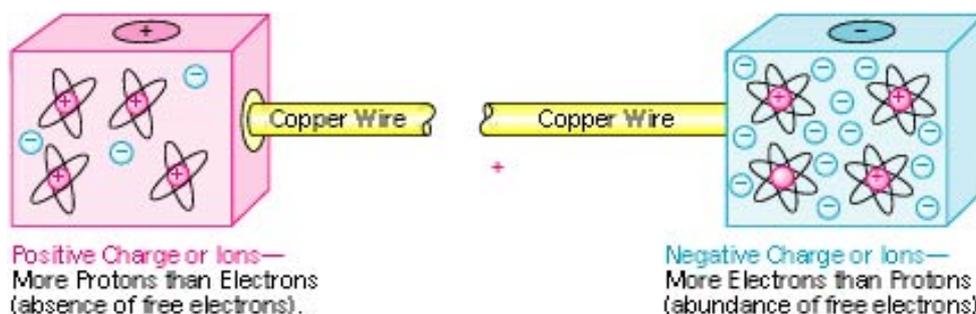


P = Proton (positive)

같은 극은 반발, 다른 극은 흡인

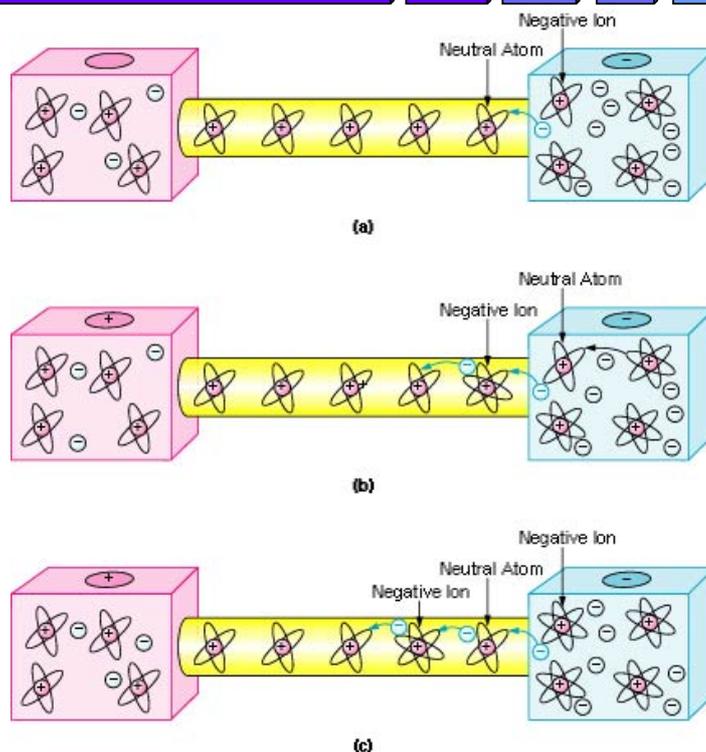
전류 (Electrical Current)

- 전류: 한 지점에서 다른 지점으로 전자가 이동하는 것
- 양이온 (positive ion): 양전하 수 > 전자 수 인 원자
- 음이온 (negative ion): 양전하 수 < 전자 수 인 원자



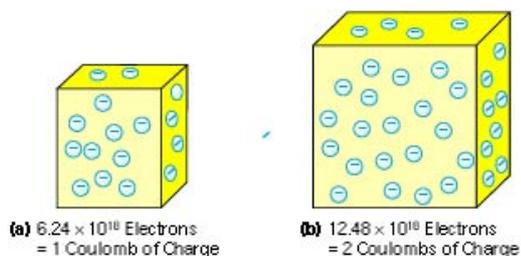
Korea University of Technology and Education

전자의 이동에 의한 전류



Korea University of Technology and Education

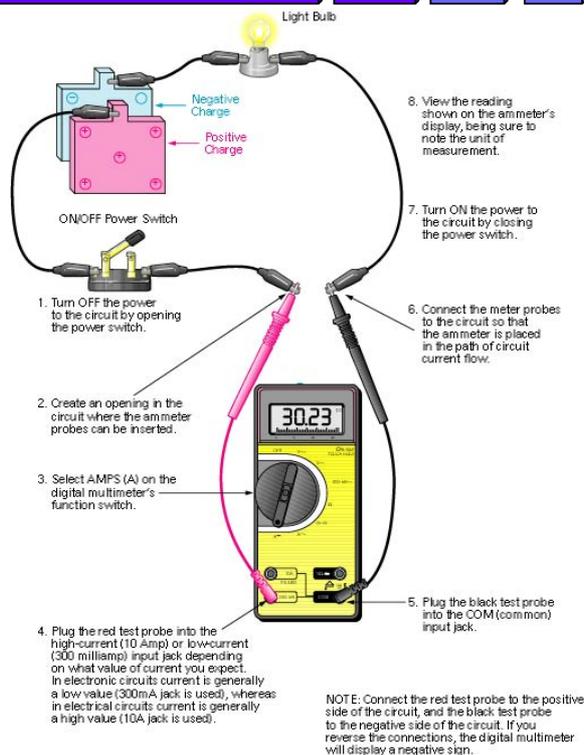
전류 (I) 의 단위



1 쿨롬 (Coulomb)의 전하에는 6.24×10^{18} 개의 전자가 존재

6.24×10^{18} 개의 전자가 1초 동안에 도체의 한 점을 통과할 때 1A의 전류가 흐른다.

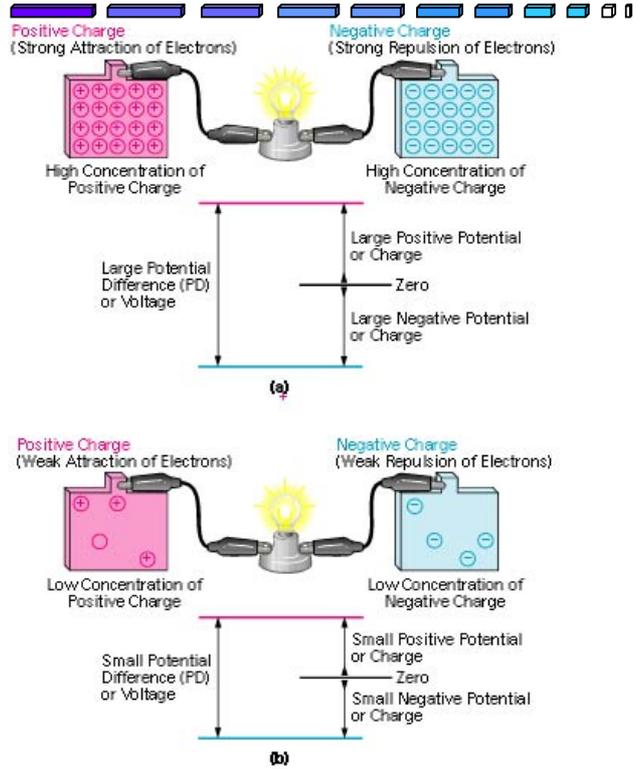
전류의 측정



낮은 저항 필요

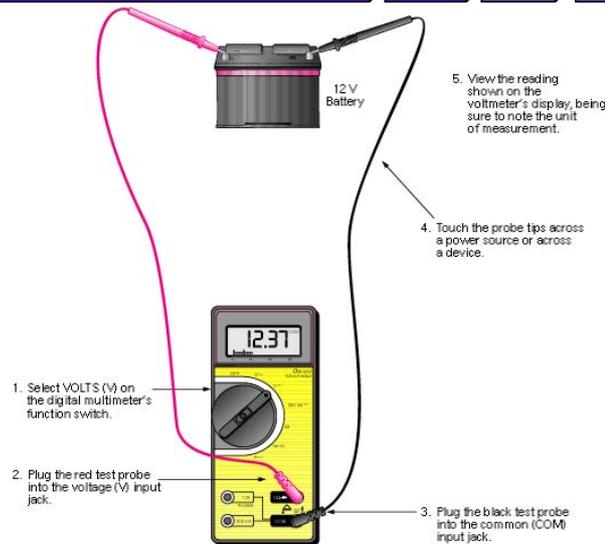
전압 (Voltage)

- 전압 (Voltage): 전자에 가하는 힘 또는 압력, 일을 할 수 있는 능력
- 전동력 (Electron moving force) 또는 기전력 (electromotive force: emf) : 두 점간의 전위차이로 인하여 전자운동이 발생하는 힘
- 단위: volt
- 1(V): 두 점 사이에 6.24×10^{18} 개의 전자를 움직이는데 필요한 전압(전위차)



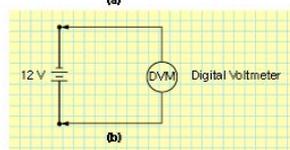
Korea University of Technology and Education

전압 측정



높은 저항 필요

NOTE: If test leads are reversed, a negative sign will show in the display.



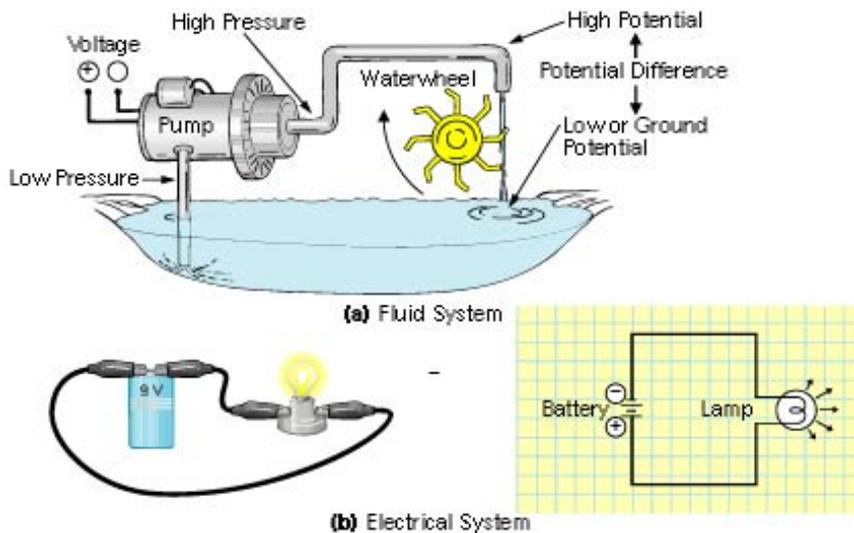
Korea University of Technology and Education

전압 전류의 단위

이름	부호	값
Pico	p	10^{-12}
Nano	n	10^{-9}
Micro	μ	10^{-6}
Milli	m	10^{-3}
Kilo	k	10^3
Mega	M	10^6
Giga	G	10^9
Tera	T	10^{12}

Korea University of Technology and Education

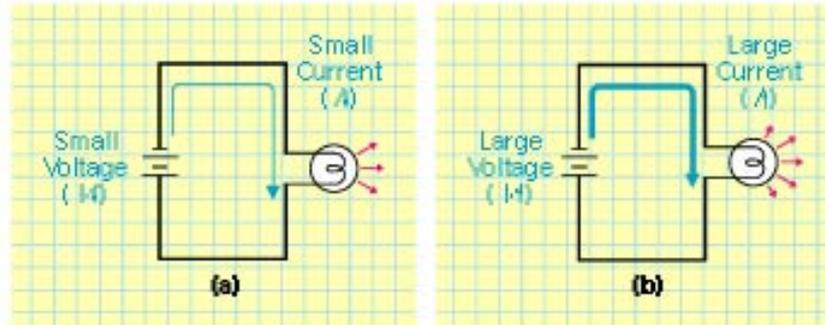
Mechanical and Electrical Analogy



(a) Fluid System	Equivalent to (=)	(b) Electrical System
Pump generates pressure, which is the water moving force.		Battery generates voltage, which is the electron moving force.
Water current flow.		Electron current flow.
High pressure or potential.		High voltage or potential.
Low pressure or potential.		Low voltage or potential.

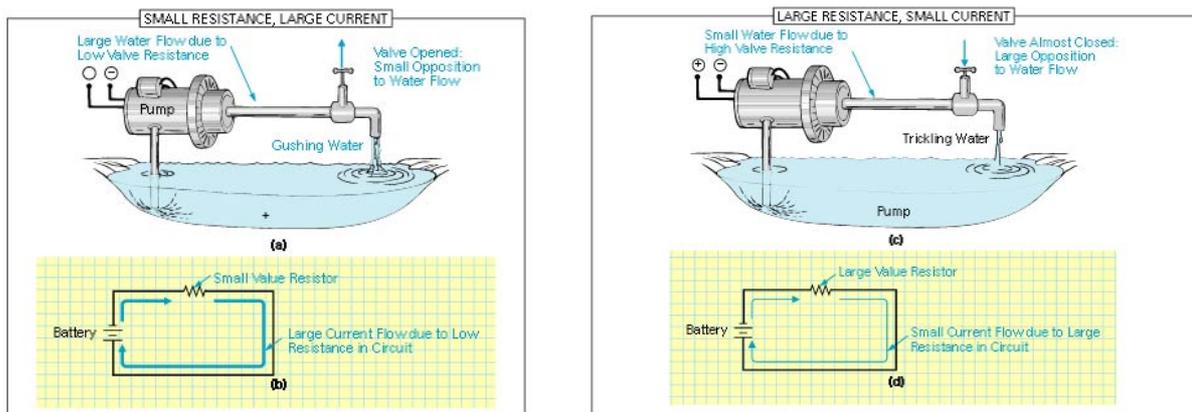
Korea University of Technology and Education

전압과 전류의 관계



전류 (I) 는 전압에 정비례 한다.
 ->압력이 증가하면 유체의 흐름도 증가

저항 (Resistance)



저항: 열의 형태로 에너지를 방사시켜 전류의 흐름을 방해하는 것

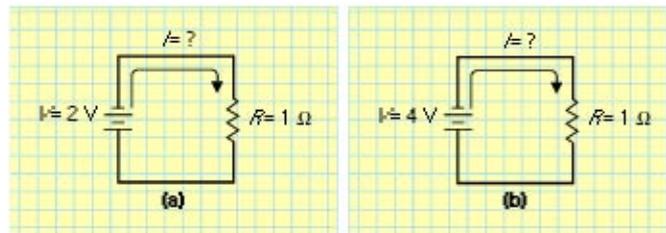
저항은 전류에 반비례

기호: R 단위: ohm [Ω]

Ohm's Law

- 회로에 흐르는 전류는 이 회로의 전압에 정비례하고 저항에 반비례 한다.

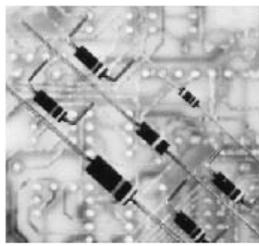
$$\text{전류}(I) = \frac{\text{전압}(V)}{\text{저항}(R)}$$



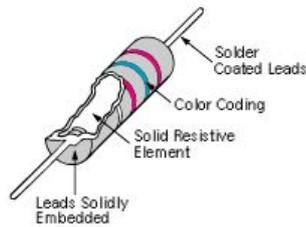
저항기 (Resistor)

- Why we use resistor ?
- Fixed-value resistor
- Variable resistor
 - 스피커로 흐르는 전류를 제어하여 음량 조절

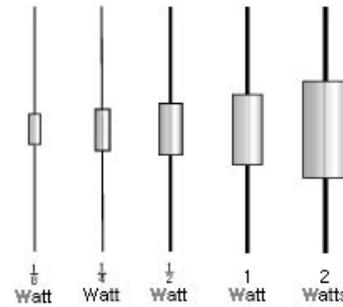
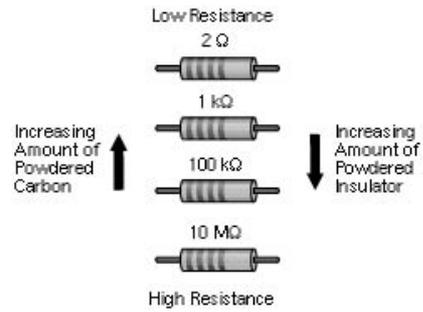
Fixed-value resistor: carbon composition resistor



(a)



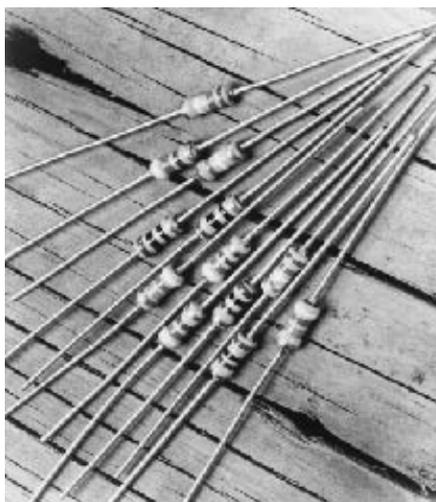
(b)



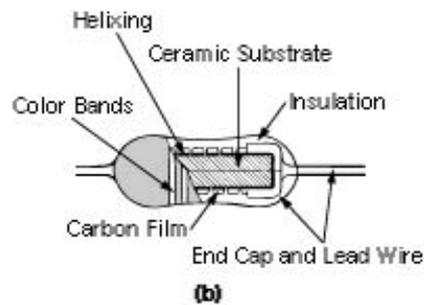
1. 염가
2. 허용오차 큼 $\pm 10\%$

Korea University of Technology and Education

Fixed-value resistor: carbon film resistor



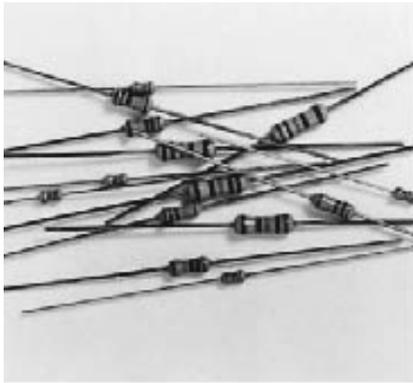
(a)



1. 온도특성 우수
2. 허용오차 $\pm 2\% \sim 5\%$

Korea University of Technology and Education

Fixed-value resistor: metal film resistor



(a)



(b)

1. 온도특성 우수
2. 허용오차 0.1% ~ 1%
3. 다른 탄소저항기에 비해 내부소음 거의 없다

Korea University of Technology and Education

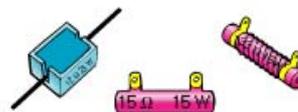
Fixed-value resistor: wirewound resistor



(a)



(b)



(c)

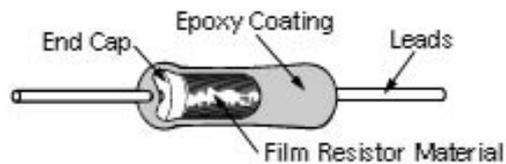
1. 절연체에 고 저항 전선(보통 니크롬선)이 감긴 저항기
2. 허용오차 1%
3. 크기가 크고 제작이 어려워 고가

Korea University of Technology and Education

Fixed-value resistor: metal oxide resistor



(a)



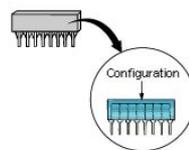
(b)

1. 온도특성 매우 우수하나 고가

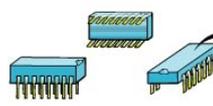
Fixed-value resistor: thick-film resistor



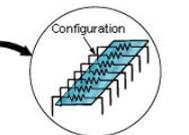
(a)



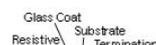
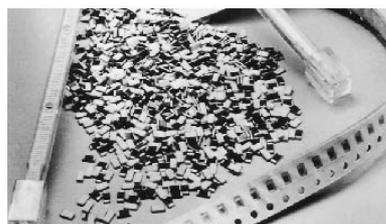
(a) SIP (Single In-line Package)



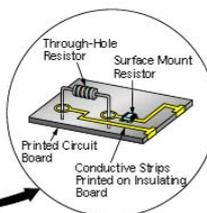
(b)



(b) DIP (Dual In-line Package)

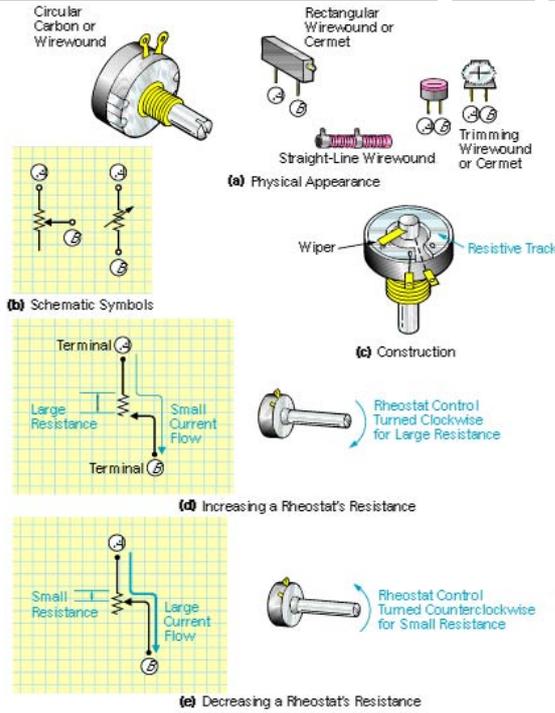


(c)



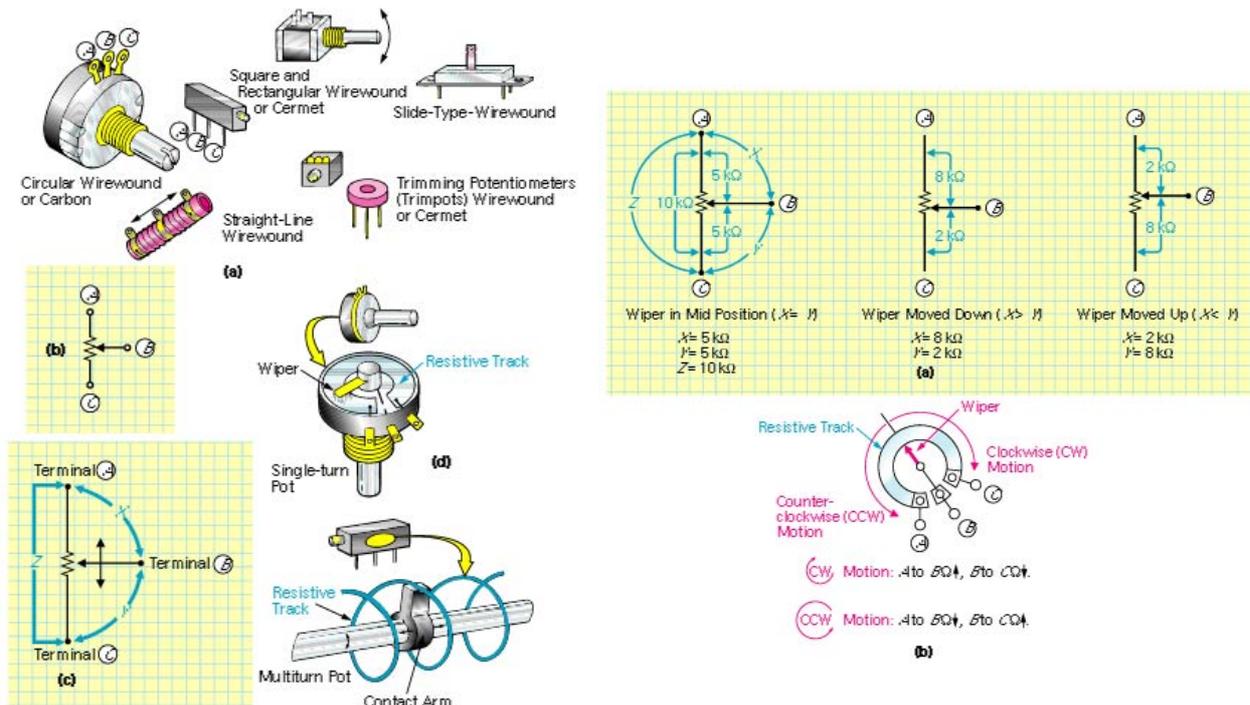
(c) Chip resistor

Variable Resistor: Rheostat (가감저항기, 단자 2개)



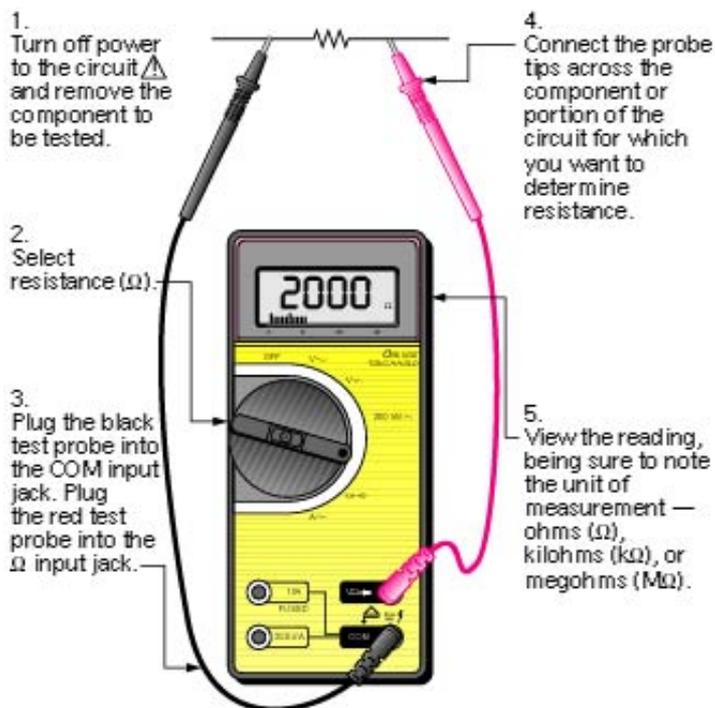
Korea University of Technology and Education

Variable Resistor: Potentiometer (전위차계, 3단자)



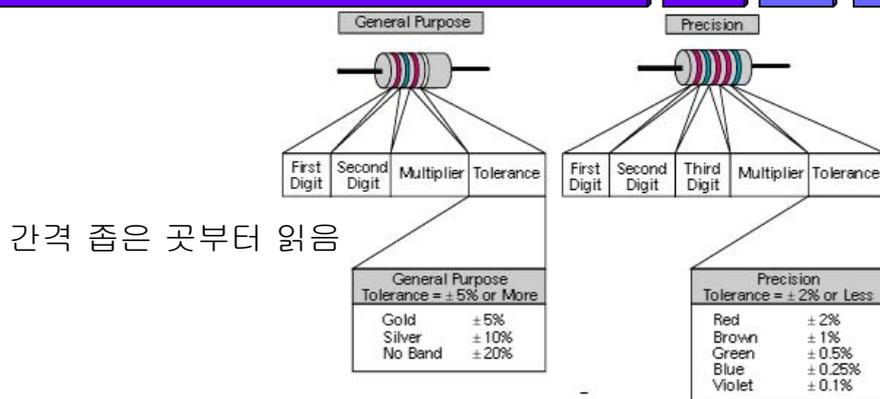
Korea University of Technology and Education

저항의 측정



계측기의 내부전원 사용

저항기 부호



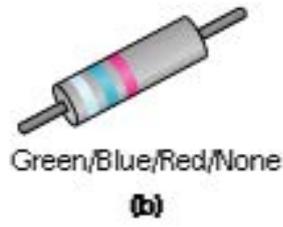
출처: 전자공학개론

	Color	Digit Value	Multiplier	
Big	Black	0	1	One
Beautiful	Brown	1	10	One Zero
Roses	Red	2	100	Two Zeros
Occupy	Orange	3	1000	Three Zeros
Your	Yellow	4	10000	Four Zeros
Garden	Green	5	100000	Five Zeros
But	Blue	6	1000000	Six Zeros
Violets	Violet	7	10000000	Seven Zeros
Grow	Gray	8	-	
Wild	White	9	-	
So	Silver	-	10 ⁻² or 0.01	1/100
Get some	Gold	-	10 ⁻¹ or 0.1	1/10
Now	None			

Examples



35, 10%

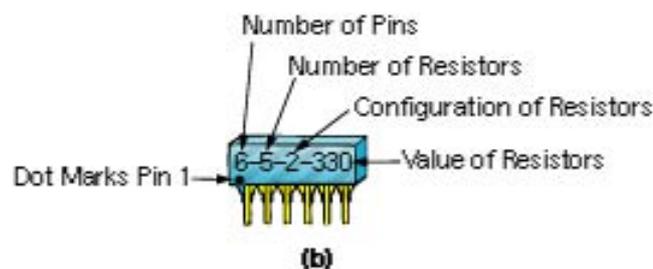
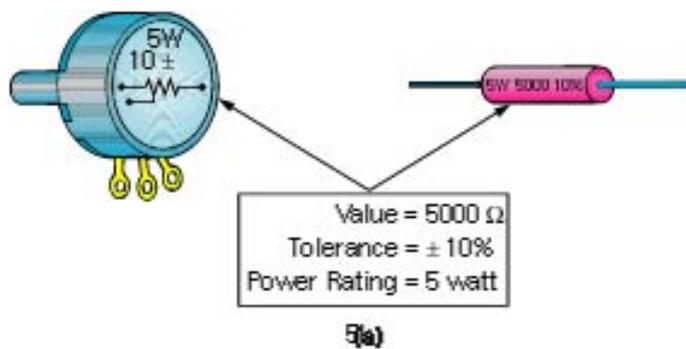


56×10^2 , 20%



225×10^{-1} , 0.25%

기타 저항 표시법



실험보고서 작성법

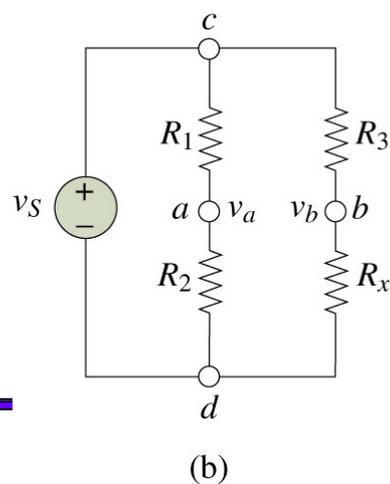
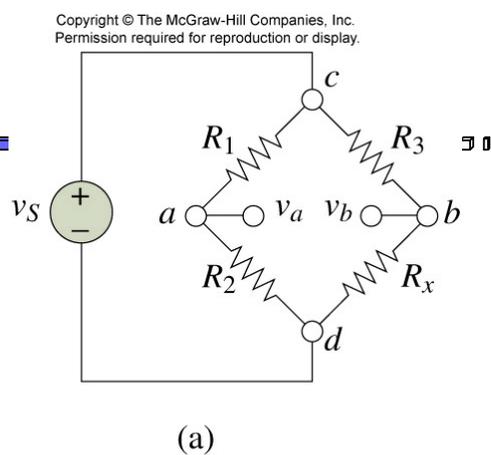
- 실험 목적
- 이론적 배경
- 실험 준비물
- 실험과정
- 실험결과
- 고찰

Korea University of Technology and Education

휘스톤 브리지 (Wheatstone bridge) 회로

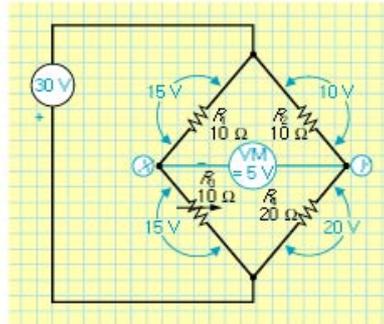
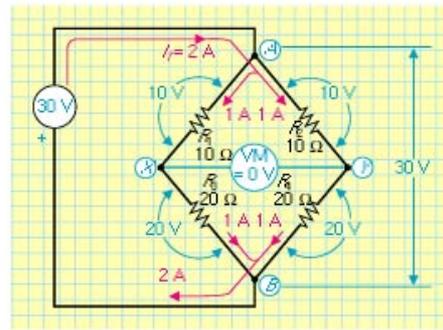
- 4가지가 일반적으로 저항으로 구성되며, 저항 측정 용도 및 여러 가지 측정 장치의 회로에 자주 사용된다.

$$V_{ab} = V_{ad} - V_{bd} = V_s \left(\frac{R_2}{R_1 + R_2} - \frac{R_x}{R_3 + R_x} \right)$$



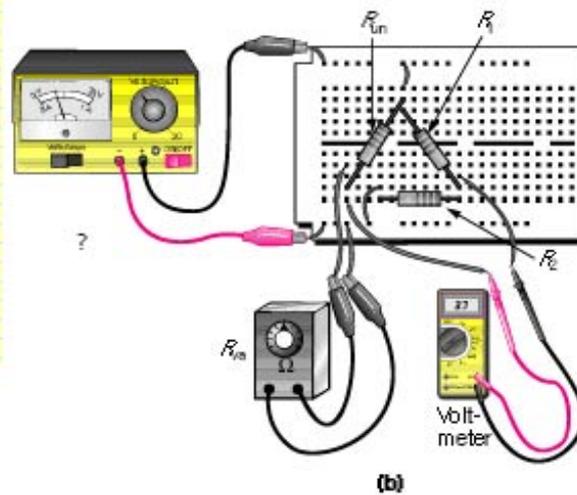
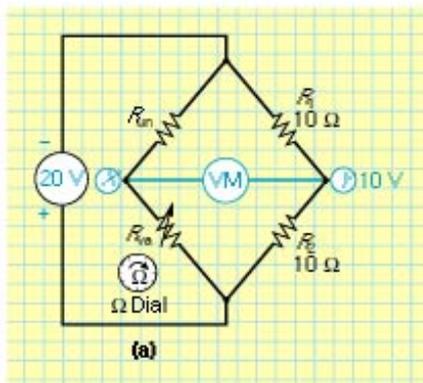
Korea University of Technology and Education

평형 및 불 평형 브리지



Korea University of Technology and Education

미지저항 결정



Korea University of Technology and Education

실험

- 1K, 10K, 22K 의 공칭저항과 실제저항 측정
- 1K, 10K 직렬 연결, 5V 인가
 - 각 지점의 전압 측정
 - 각 지점의 전류 측정

- 5K 가변저항
 - 저항변화 측정
 - 전압분배 측정