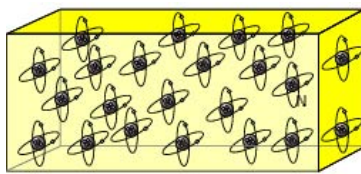


Basic Elements of Electricity

Jee-Hwan Ryu

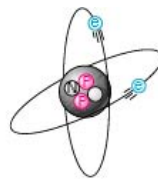
School of Mechanical Engineering
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물질의 구조



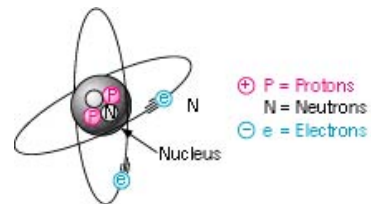
(a)

(a) 원소: 여러 유사 원자

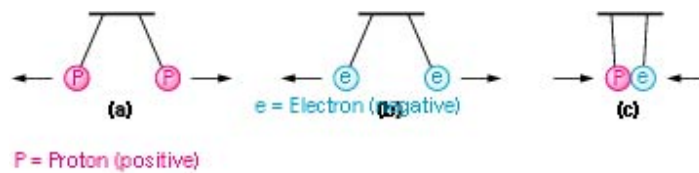


(b)

(b) 원자: 최소단위



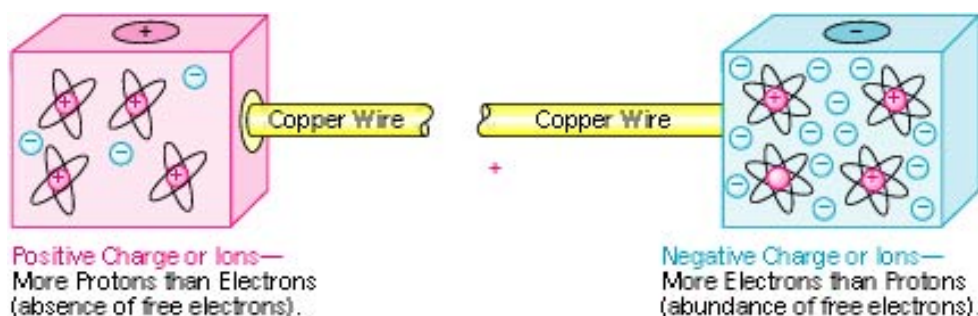
Protons: 양자
Neutrons: 중성자
Electrons: 전자



같은 극은 반발, 다른 극은 흡인

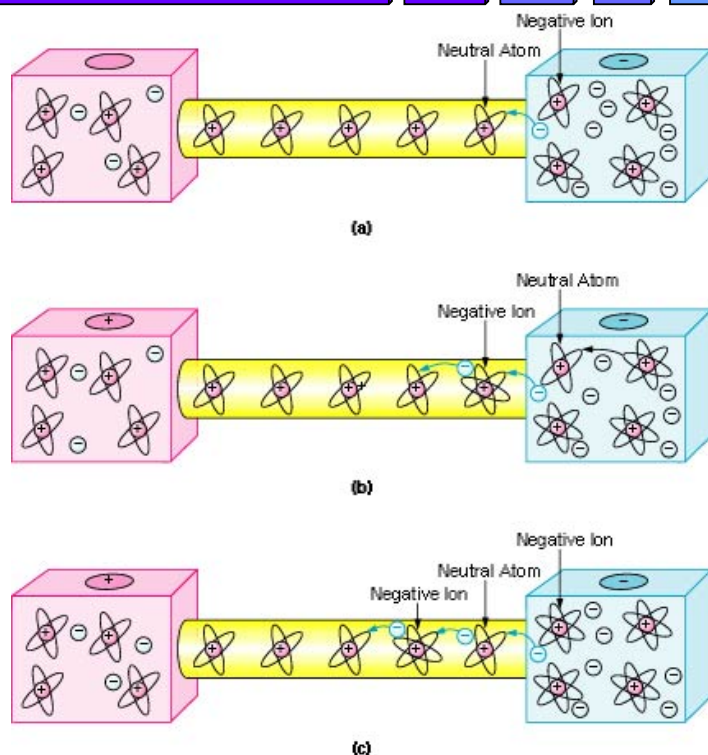
전류 (Electrical Current)

- 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



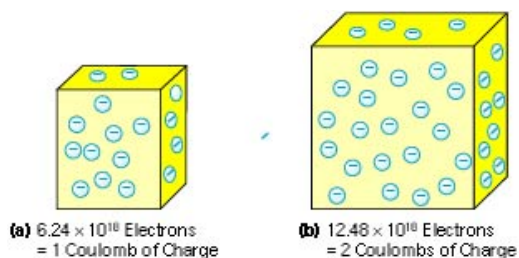
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전자의 이동에 의한 전류



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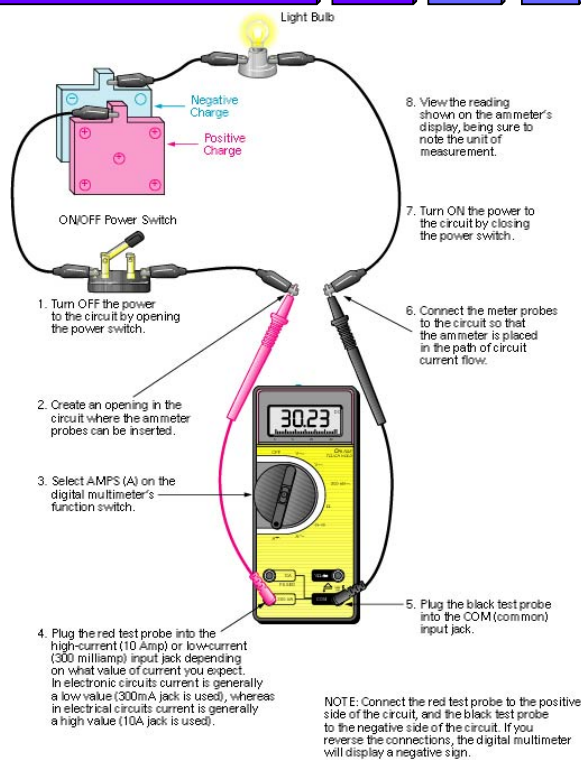
전류 (I) 의 단위



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.

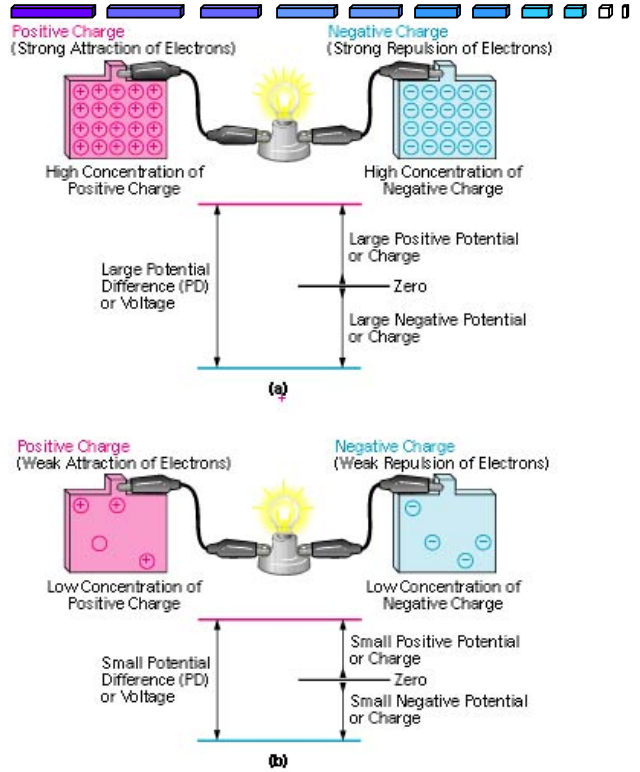
전류의 측정



낮은 저항 필요

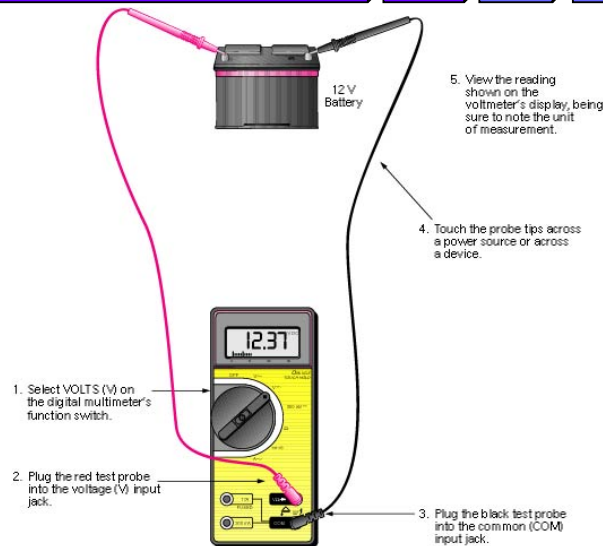
전압 (Voltage)

- 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)



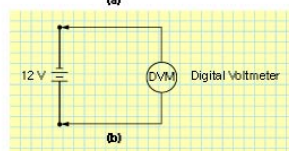
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전압 측정



높은 저항 필요

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



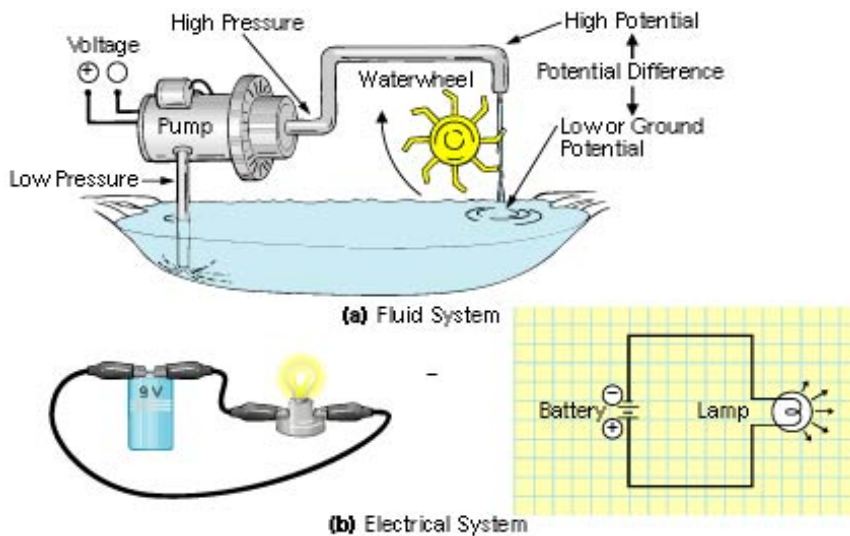
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전압 전류의 단위

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}

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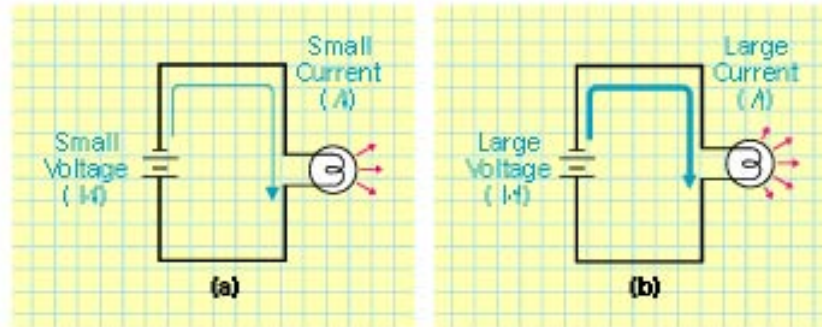
Mechanical and Electrical Analogy



(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.

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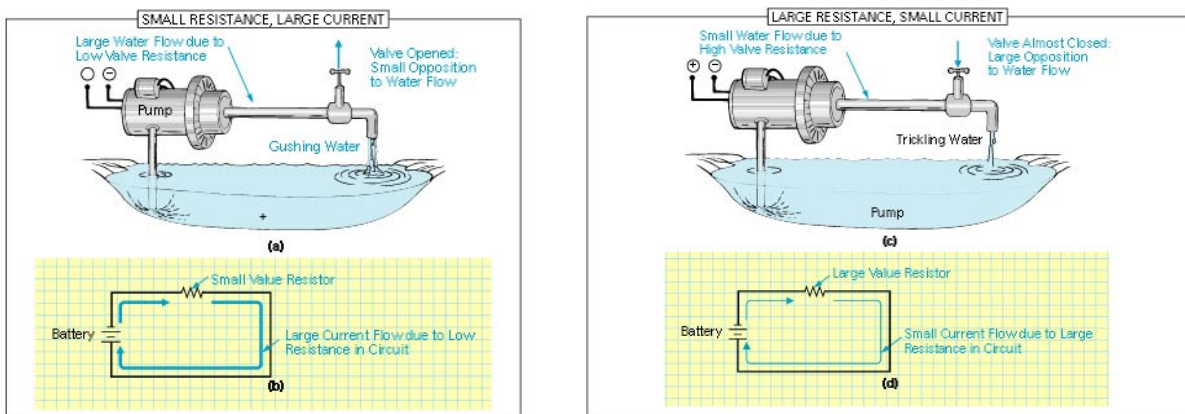
전압과 전류의 관계



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

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저항 (Resistance)



저항: 열의 형태로 에너지를 방사시켜 전류의 흐름을 방해하는 것

저항은 전류에 반비례

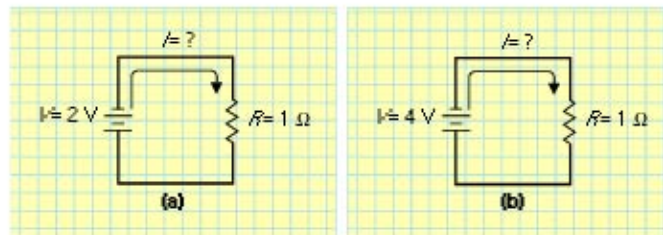
기호: R 단위: ohm [Ω]

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Ohm's Law

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

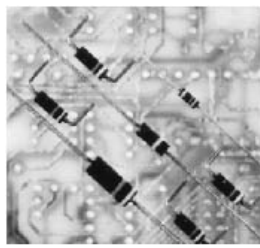
$$\text{전류}(I) = \frac{\text{전압}(V)}{\text{저항}(R)}$$



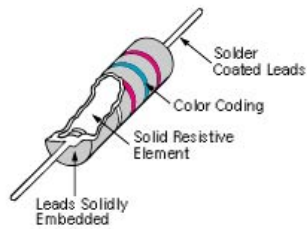
저항기 (Resistor)

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

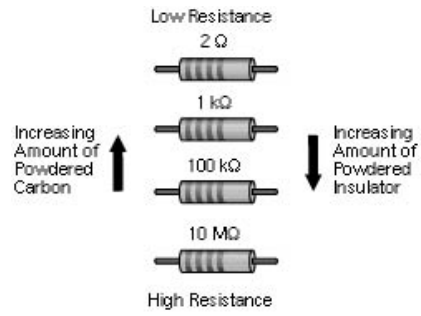
Fixed-value resistor: carbon composition resistor



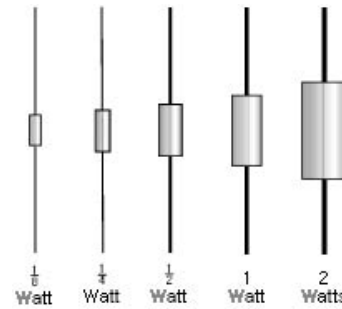
(a)



(b)

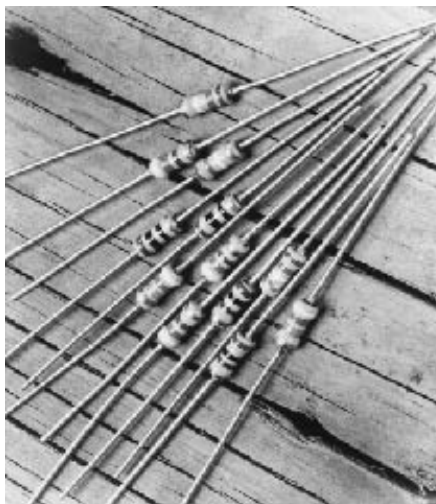


1. 염가
2. 허용오차 큼 ±10%

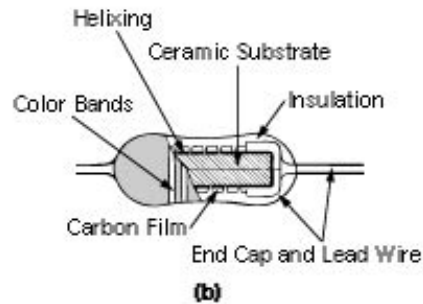


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Fixed-value resistor: carbon film resistor



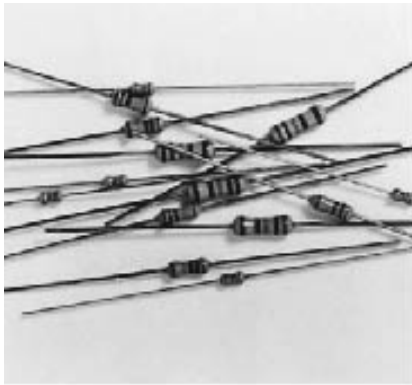
(a)



1. 온도특성 우수
2. 허용오차 ±2% ~ 5%

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Fixed-value resistor: metal film resistor



(a)



(b)

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

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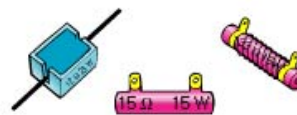
Fixed-value resistor: wirewound resistor



(a)



(b)



(c)

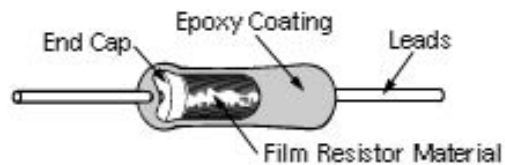
1. 절연체에 고 저항 전선(보통 니크롬선)이 감긴 저항기
2. 허용오차 1%
3. 크기가 크고 제작이 어려워 고가

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Fixed-value resistor: metal oxide resistor



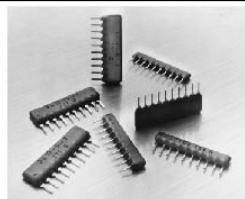
(a)



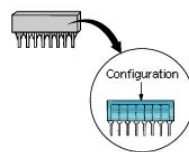
(b)

1. 온도특성 매우 우수하나 고가

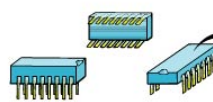
Fixed-value resistor: thick-film resistor



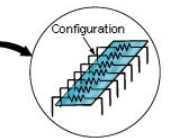
(a)



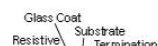
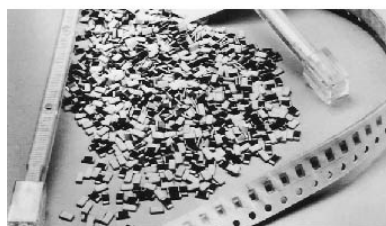
(a) SIP (Single In-line Package)



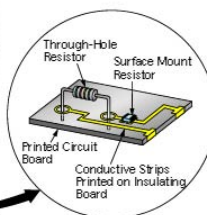
(b)



(b) DIP (Dual In-line Package)

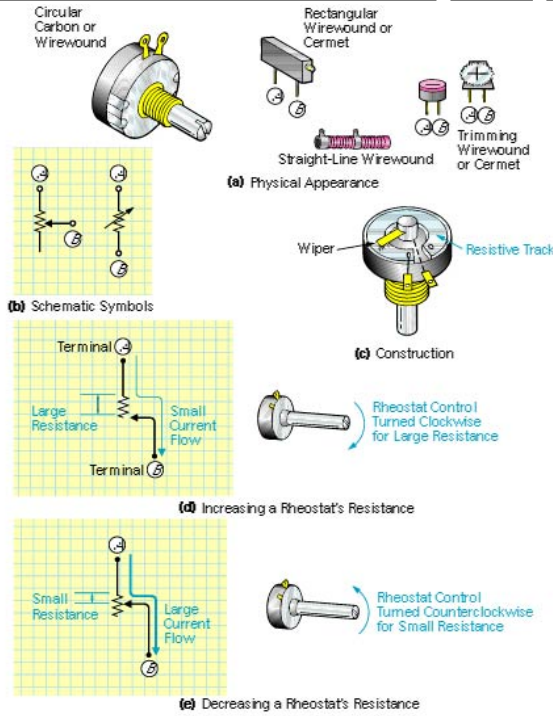


(c)



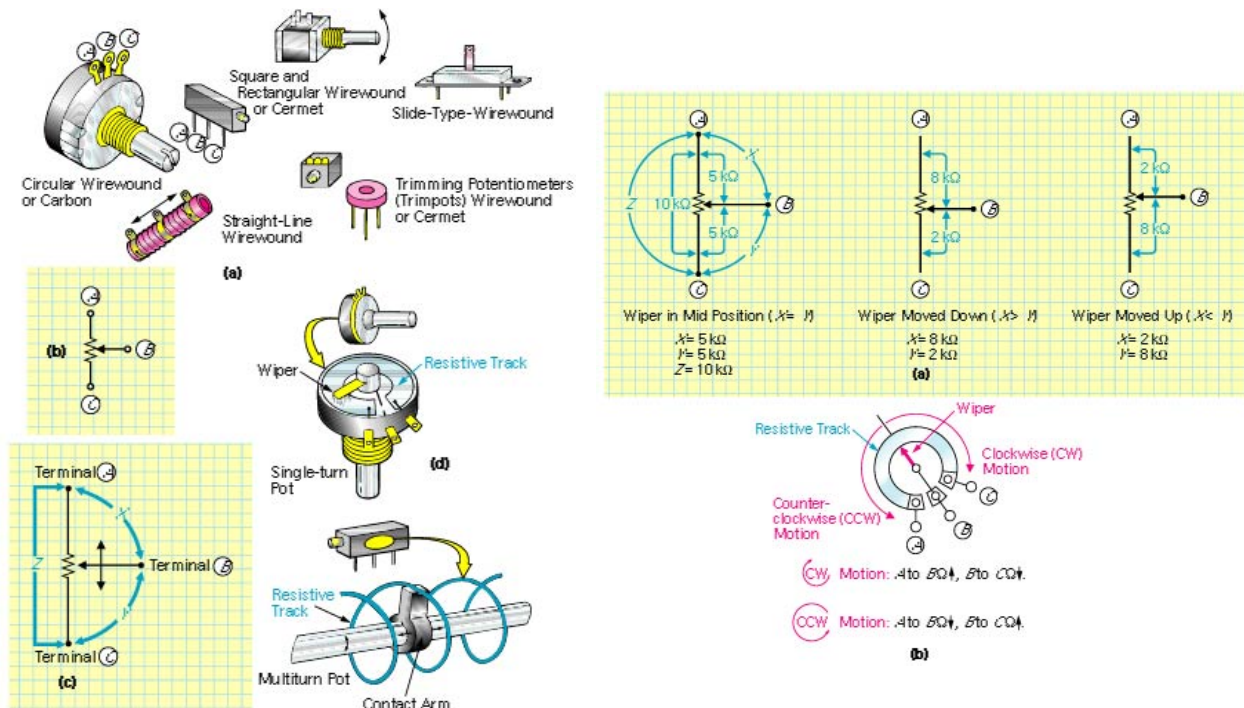
(c) Chip resistor

Variable Resistor: Rheostat (가감저항기, 단자 2개)



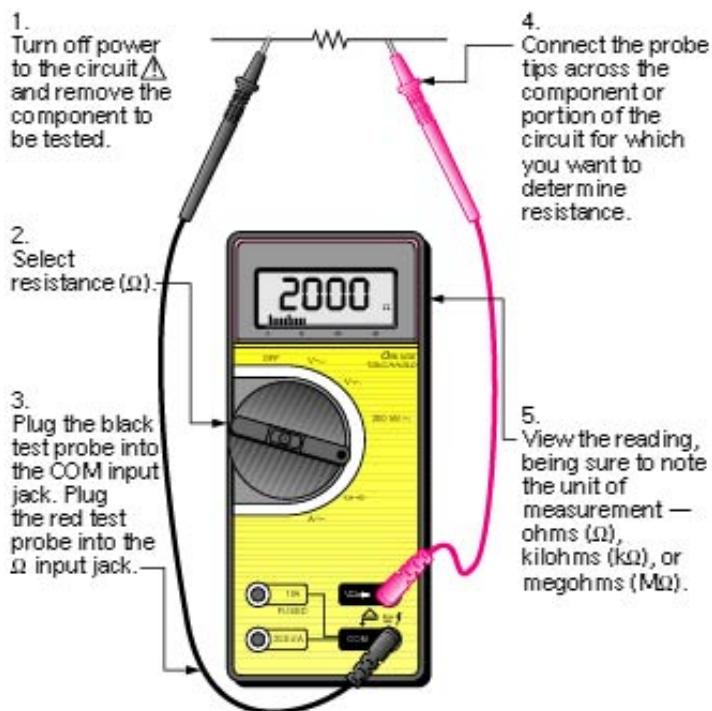
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Variable Resistor: Potentiometer (전위차계, 3단자)



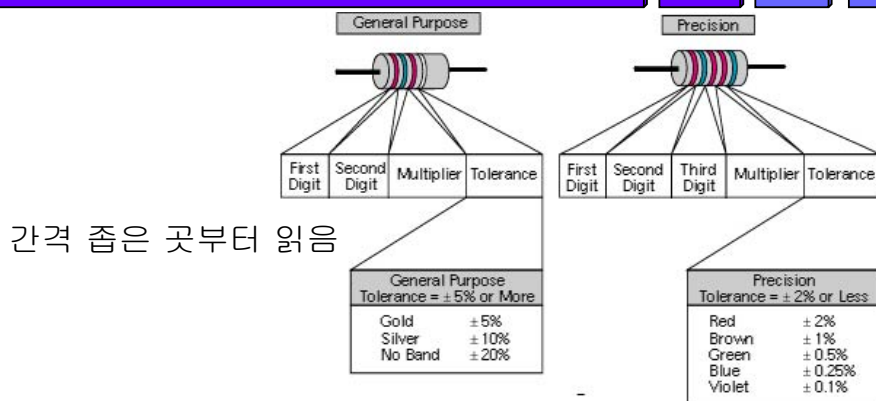
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저항의 측정



계측기의 내부전원 사용

저항기 부호



출처: 전자공학개론

	Color	Digit Value	Multiplier	
Big	Black	0	1 One	1
Beautiful	Brown	1	10 One Zero	10
Roses	Red	2	100 Two Zeros	100
Occupy	Orange	3	1000 Three Zeros	1 k
Your	Yellow	4	10000 Four Zeros	10 k
Garden	Green	5	100000 Five Zeros	100 k
But	Blue	6	1000000 Six Zeros	1 M
Violets	Violet	7	10000000 Seven Zeros	10 M
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%

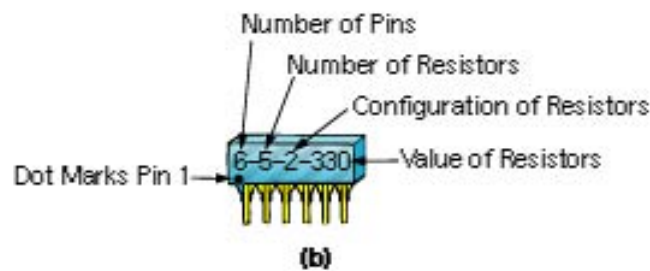
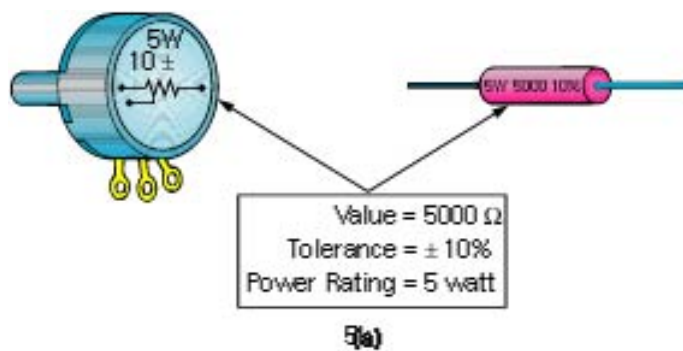


56×10^2 , 20%



225×10^{-1} , 0.25%

기타 저항 표시법



실험보고서 작성법

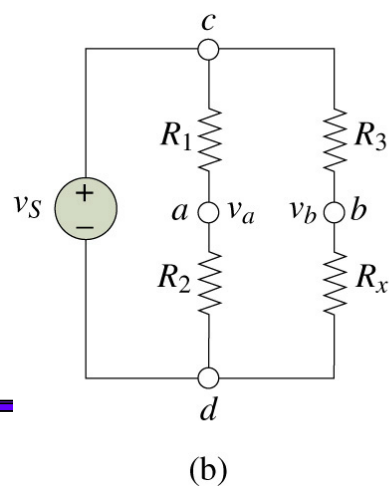
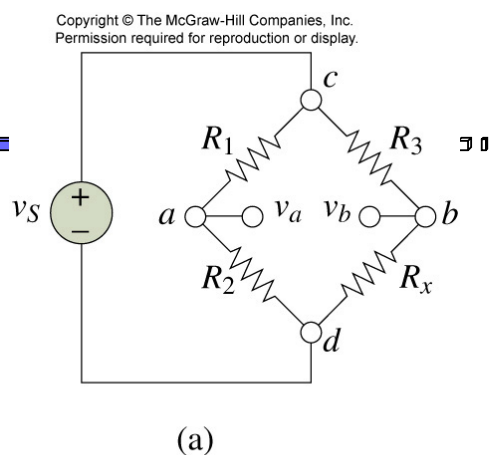
- 실험 목적
- 이론적 배경
- 실험 준비물
- 실험과정
- 실험결과
- 고찰

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휘스톤 브리지 (Wheatstone bridge) 회로

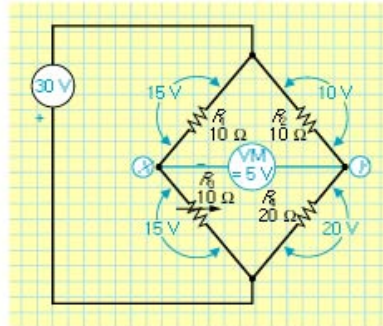
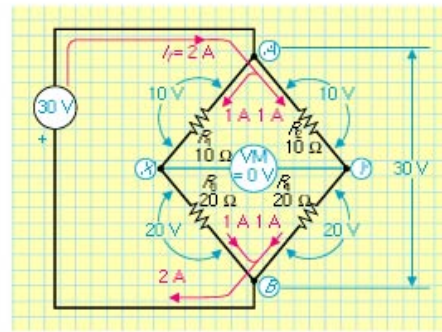
- 4가지가 일반적으로 저항으로 구성되며, 저항 측정 용도 및 여러 가지 측정 장치의 회로에 자주 사용된다.

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



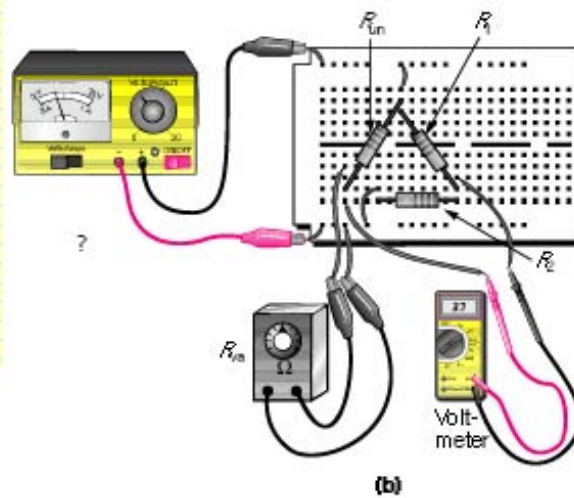
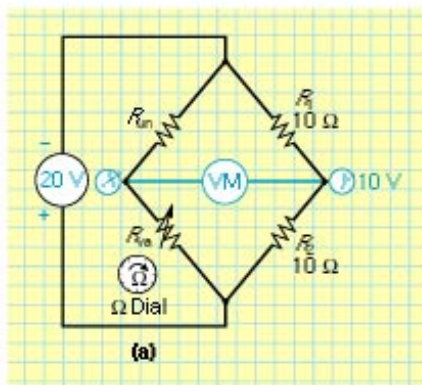
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평형 및 불 평형 브리지



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미지저항 결정



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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