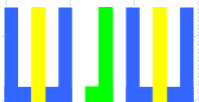


회로 이론/실습

2. 직렬로 연결된 저항 회로의 전류, 전압 및 전력



2. 직렬로 연결된 저항 회로의 전류, 전압 및 전력

2-1. 목적 및 배경

2-2. 소요 부품 및 장비

2-3. 유용한 공식

2-4. 디지털 멀티미터 (저항 측정)

2-5. 저항 측정

2-6. 저항 측정과 측정 범위의 선택

2-7. 디지털 멀티미터 (전류 측정)

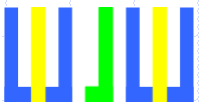
2-8. 전류 측정

2-9. 디지털 멀티미터 (전압 측정)

2-10. 전압 측정

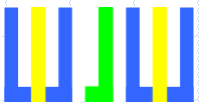
2-11. 전류, 전압 측정 및 전력 계산

2-12. 직류 전원 공급기



2-1. 목적 및 배경

- ✓ 저항이 직렬로 연결될 때 총저항의 값을 계산한다.
- ✓ 디지털 멀티미터 (Digital Multi-Meter : DMM) 를 이용하여 직렬로 연결된 저항값을 측정한다.
- ✓ 디지털 멀티미터 (Digital Multi-Meter : DMM) 를 이용하여 직렬로 연결된 회로의 전압과 전류를 측정한다.
- ✓ 측정된 전압과 전류를 이용하여 전력을 계산한다.



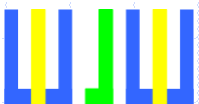
2-2. 소요 부품 및 장비

✓ 부품

- ✓ 저항 (1/4W) : 100 Ω , 200 Ω , 1k Ω , 3k Ω , 4.7k Ω , 1M Ω

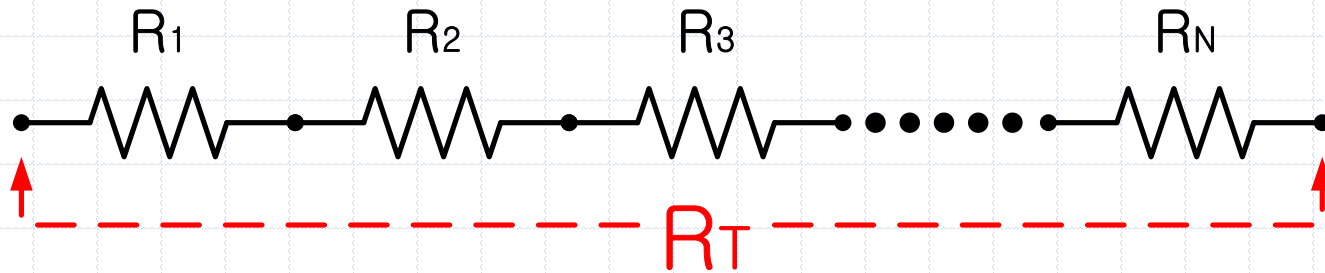
✓ 장비

- ✓ 브레드 보드
- ✓ 디지털 멀티미터 (Digital Multi-Meter)
- ✓ 직류 전원 공급 장치 (DC Power Supply)

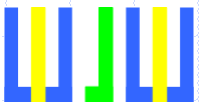


2-3. 유용한 공식

✓ 저항의 직렬 연결



$$R_T = R_1 + R_2 + R_3 + \dots + R_N$$



2-3. 유용한 공식

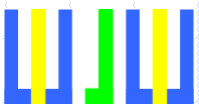
- ✓ 옴의 법칙 (Ohm's Law)

$$V = IR, \quad I = \frac{V}{R}, \quad R = \frac{V}{I}$$

V : 전압 (Voltage, V), I : 전류 (Currents, A), R : 저항 (Resistor, Ω)

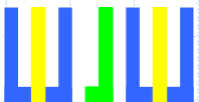
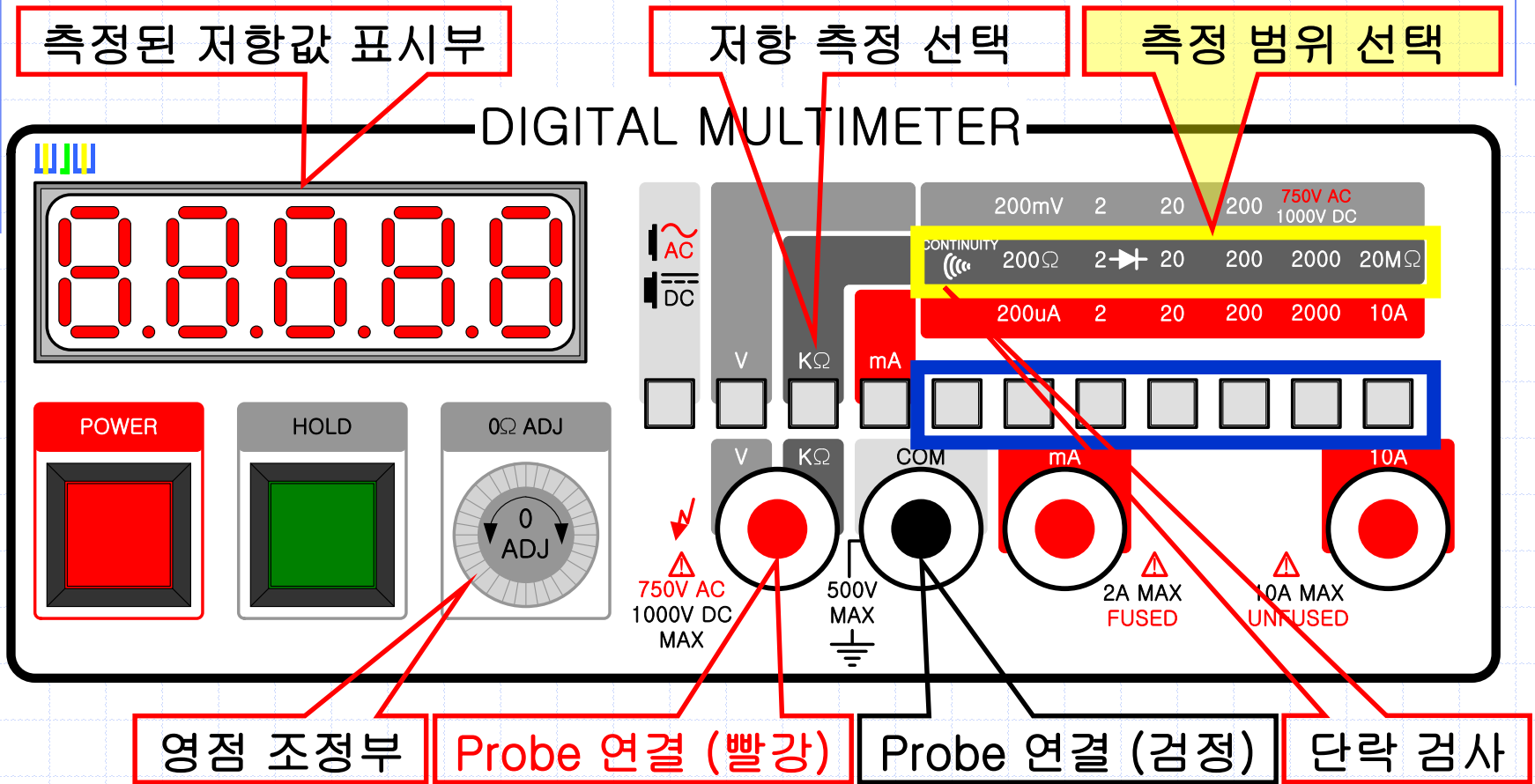
- ✓ 전력 (Power), P, W, Watt

$$P = VI = I^2R = \frac{V^2}{R}$$



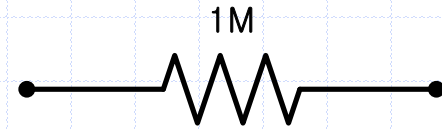
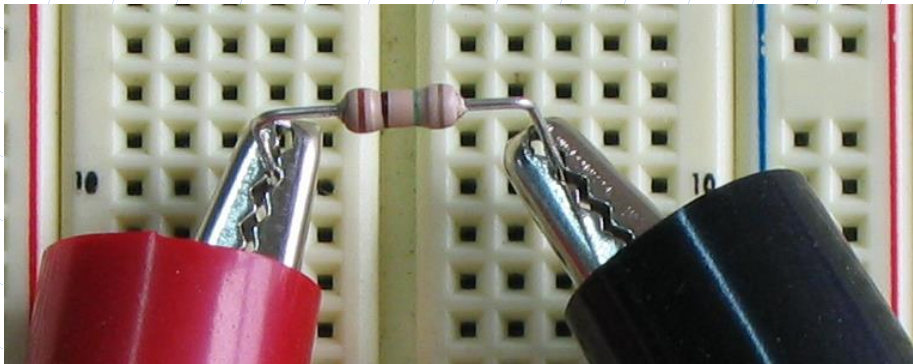
2-4. 디지털 멀티미터 (DMM)-저항 측정

✓ Digita Multi Meter 사용하기 (저항 측정)



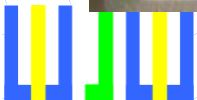
2-5A. 저항 측정

✓ 저항 측정



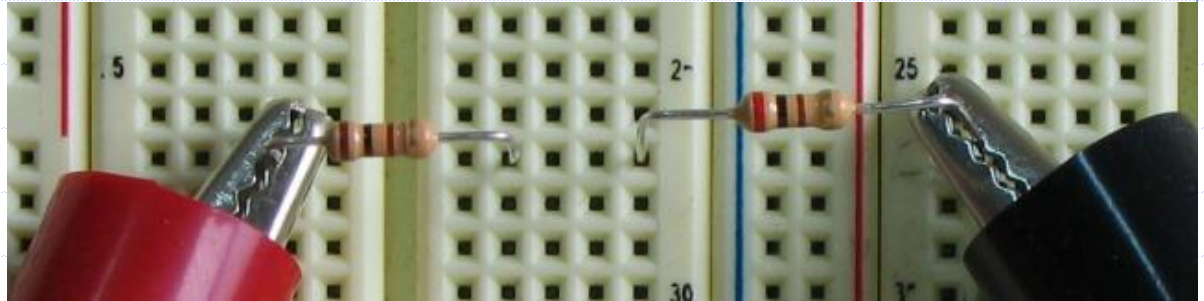
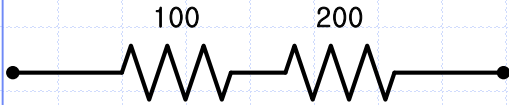
갈 검 녹

$$10 \times 100,000 = 1 \text{ M}\Omega$$



2-5B. 저항 측정

✓ 직렬 저항 측정

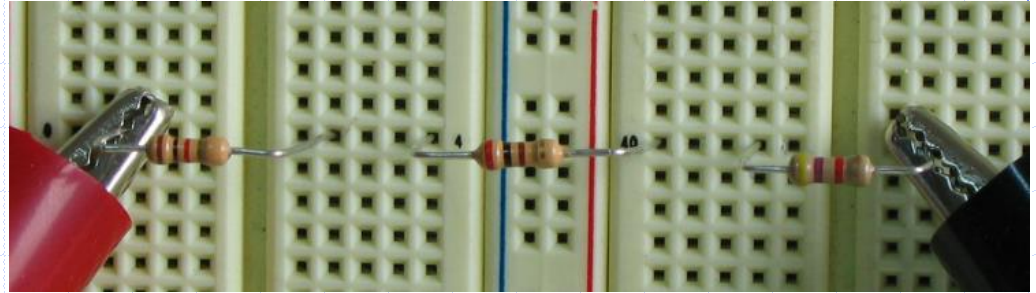
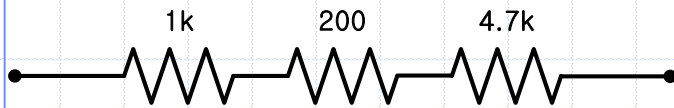


$$R_T = R_1 + R_2 = 100\Omega + 200\Omega = 300\Omega$$

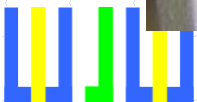


2-5C. 저항 측정

✓ 직렬 저항 측정



$$R_T = R_1 + R_2 + R_3 = 1\text{k}\Omega + 200\Omega + 4.7\text{k}\Omega = 5900\Omega = 5.9\text{k}\Omega$$



2-6. 저항 측정과 측정 범위 선택

✓ 저항값 1kΩ을 여러 가지 측정 범위로 측정



측정 범위 : 0 ~ 200Ω
 측 정 값 : 측정 불가 (OL)
 측정 범위 넘음



측정 범위 : 0 ~ 2kΩ
 측 정 값 : 0.9996kΩ=999.6Ω
 오차 : 0.04%



측정 범위 : 0 ~ 20kΩ
 측 정 값 : 0.998kΩ=998Ω
 오차 : 0.2%



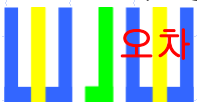
측정 범위 : 0 ~ 200kΩ
 측 정 값 : 0.97kΩ=970Ω
 오차 : 3%



측정 범위 : 0 ~ 2000kΩ
 측 정 값 : 0.7kΩ=700Ω
 오차 : 30%

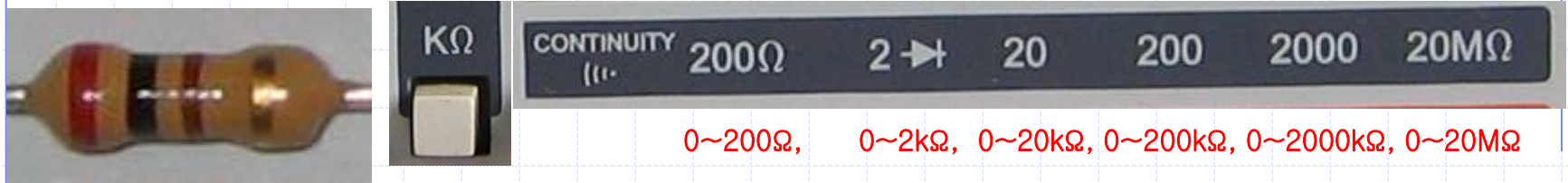


측정 범위 : 0 ~ 20MΩ
 측 정 값 : 0.003MΩ=300Ω
 오차 : 200%



2-6. 저항 측정과 측정 범위 선택

✓ 저항값 200Ω을 여러 가지 측정 범위로 측정



측정 범위 : 0 ~ 200Ω
 측 정 값 : 199.05Ω
 오차 : 0.475%



측정 범위 : 0 ~ 2kΩ
 측 정 값 : 0.2004kΩ=200.4Ω
 오차 : 0.2%



측정 범위 : 0 ~ 20kΩ
 측 정 값 : 0.197kΩ=197Ω
 오차 : 1.5%



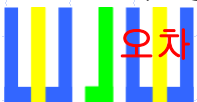
측정 범위 : 0 ~ 200kΩ
 측 정 값 : 0.21kΩ=210Ω
 오차 : 5%



측정 범위 : 0 ~ 2000kΩ
 측 정 값 : 0.3kΩ=300Ω
 오차 : 50%

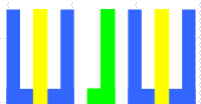
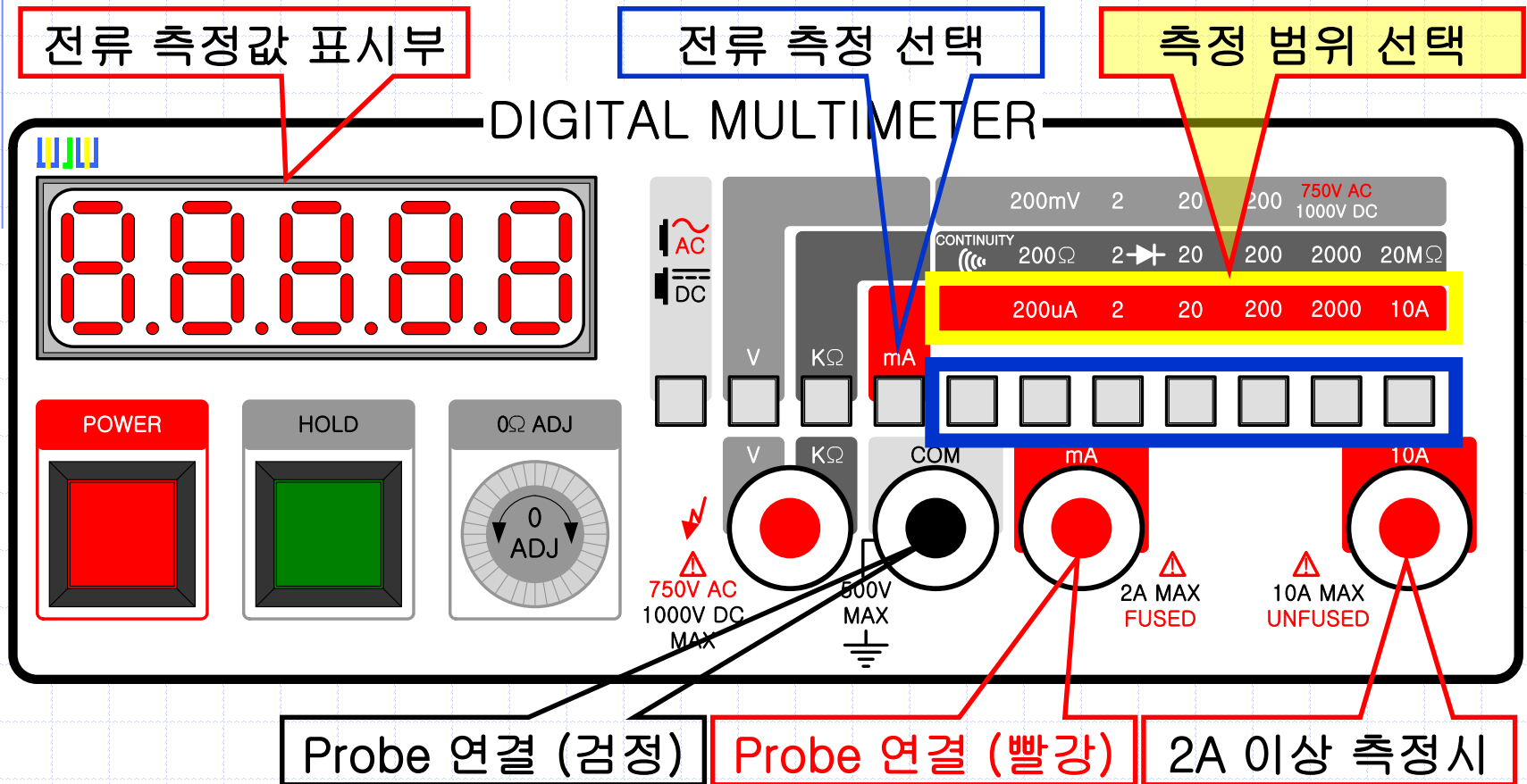


측정 범위 : 0 ~ 20MΩ
 측 정 값 : 0.011MΩ
 오차 : 45%



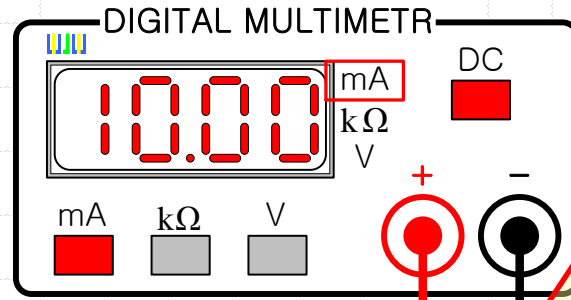
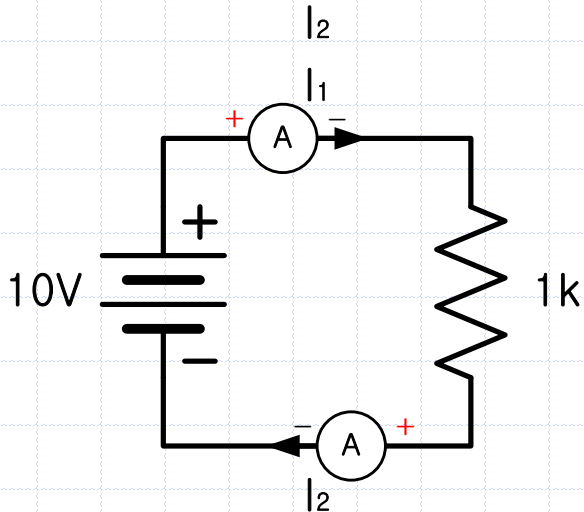
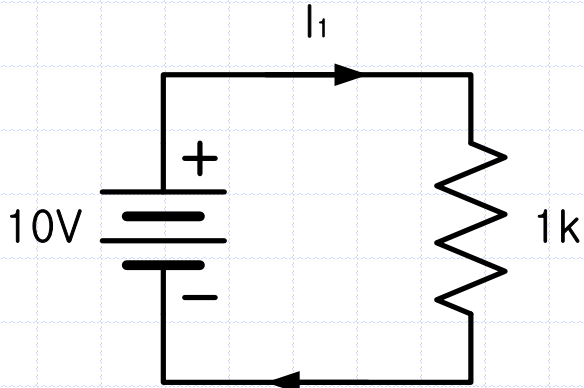
2-7. 디지털 멀티미터 (DMM)-전류 측정

✓ DMM 사용하기 (전류 측정)

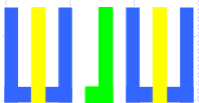
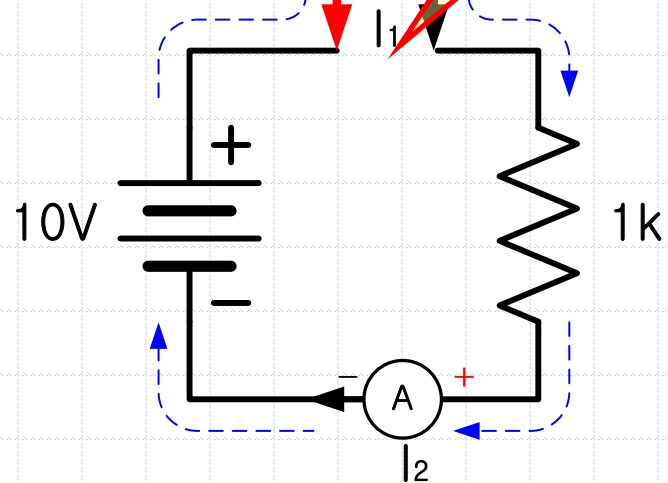


2-8A. 전류 측정

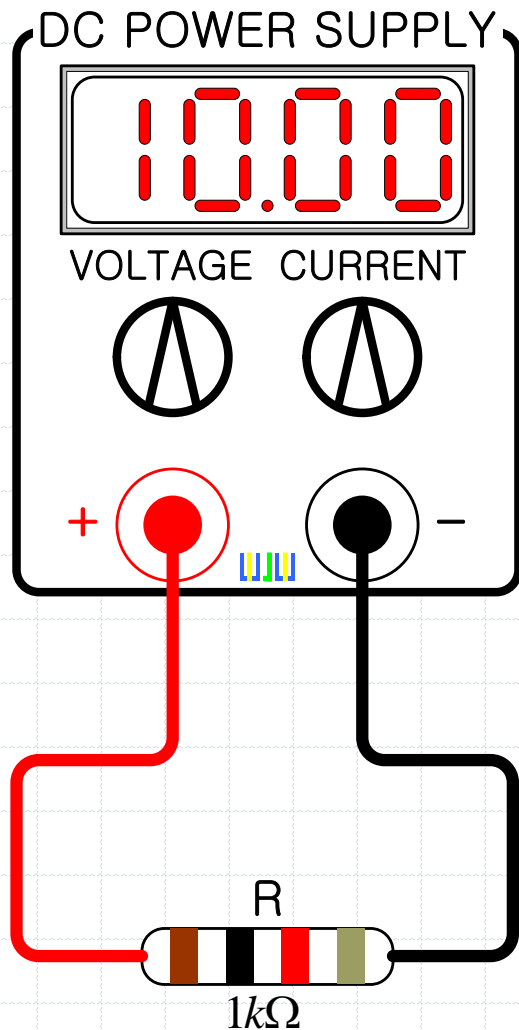
✓ 전류의 측정 방법 : 회로와 직렬로 연결하여 측정



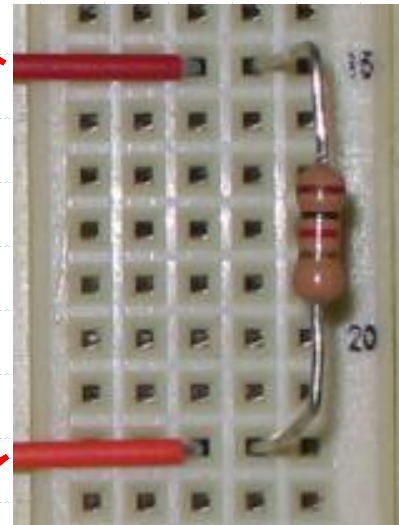
전류의 흐름을 측정하기 위하여 회로를 끊고 그 사이에 전류계를 넣어 측정



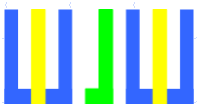
2-8A. 전류 측정



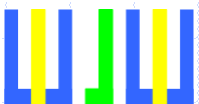
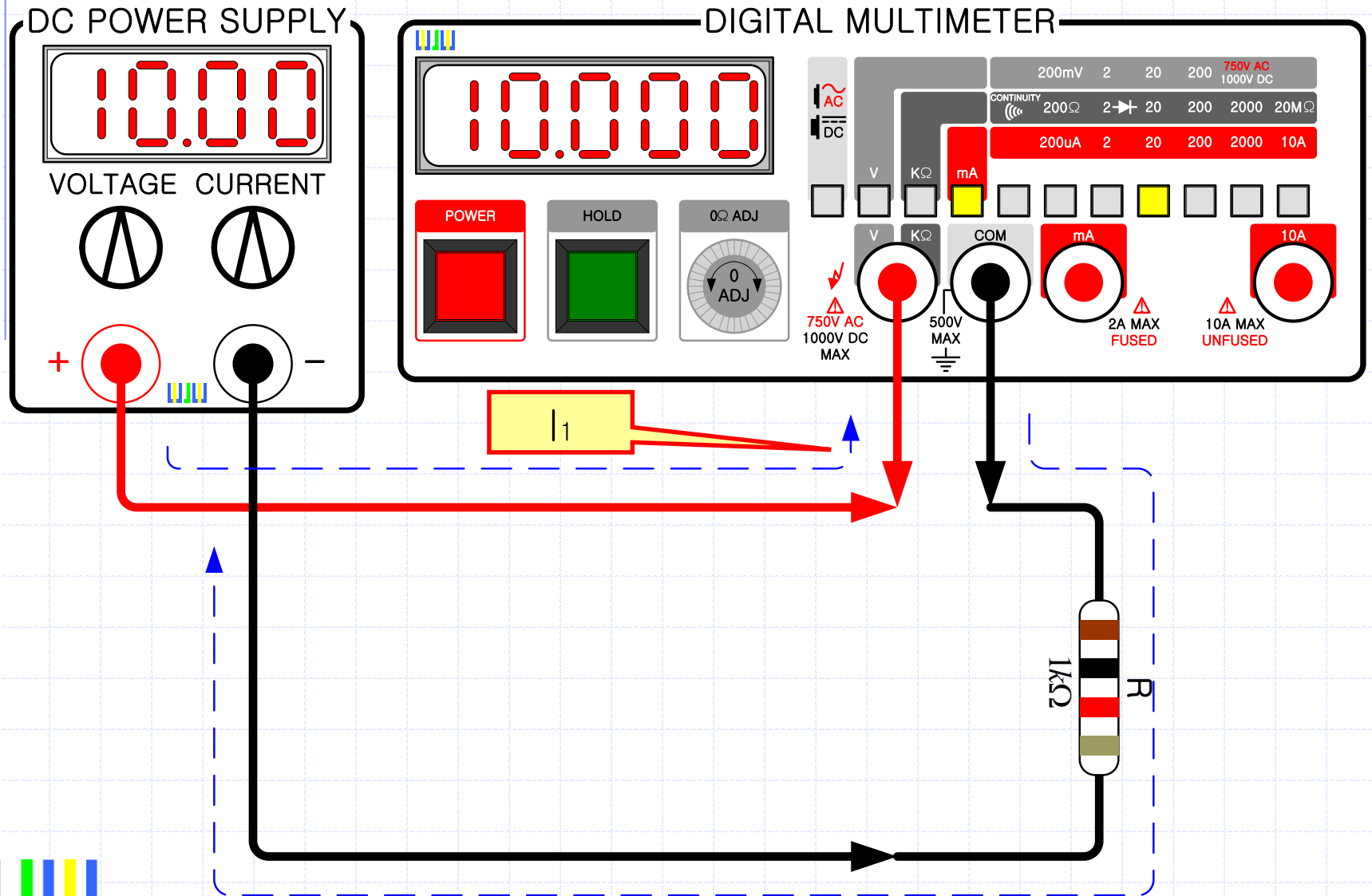
+10V



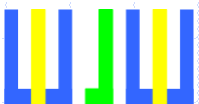
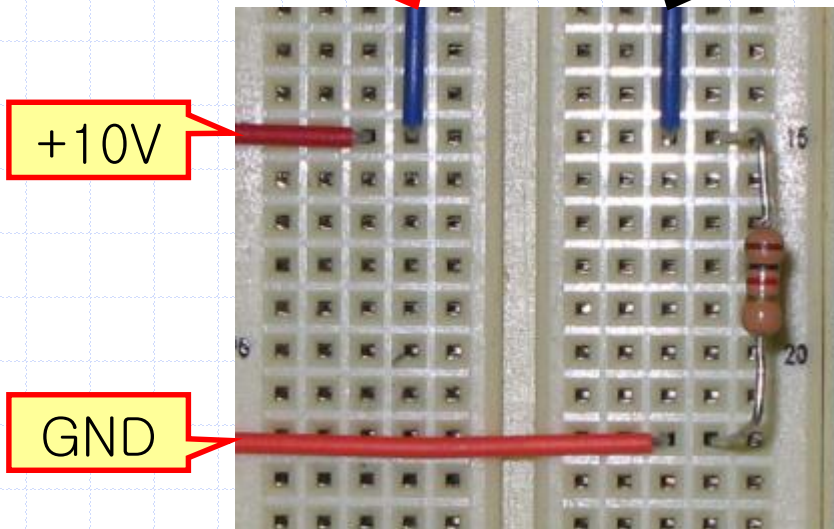
GND



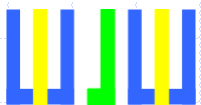
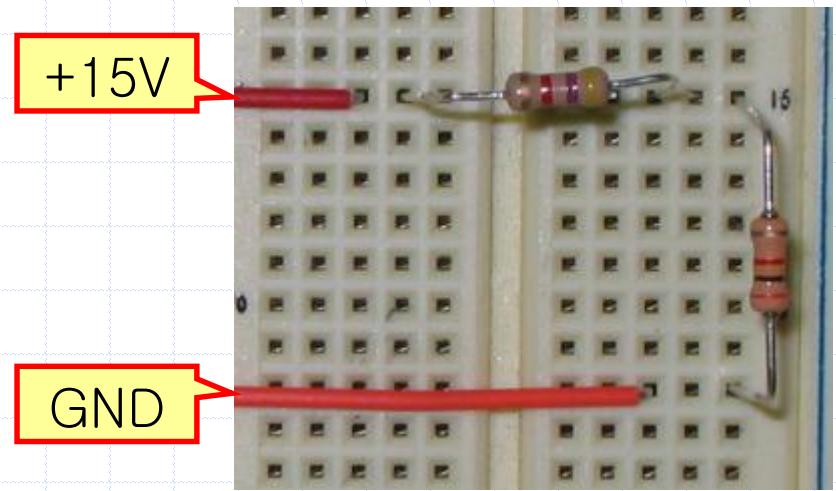
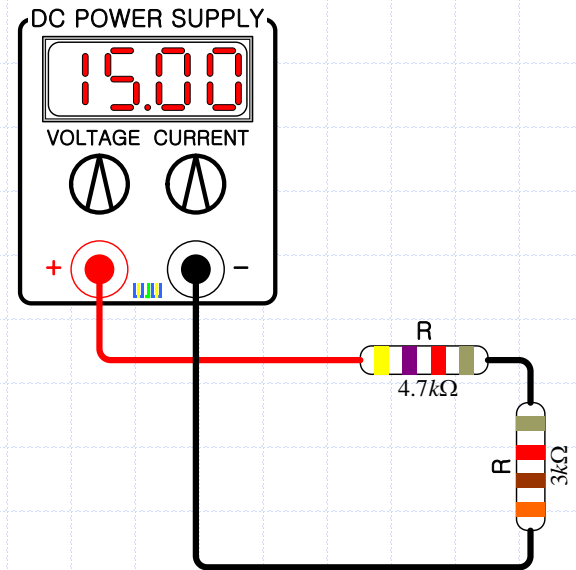
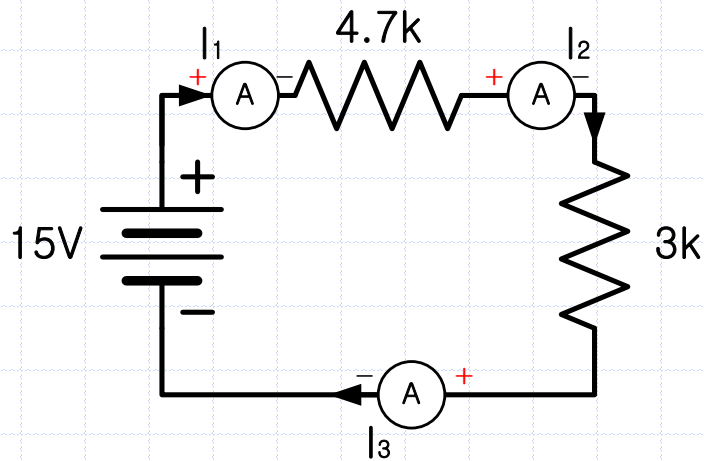
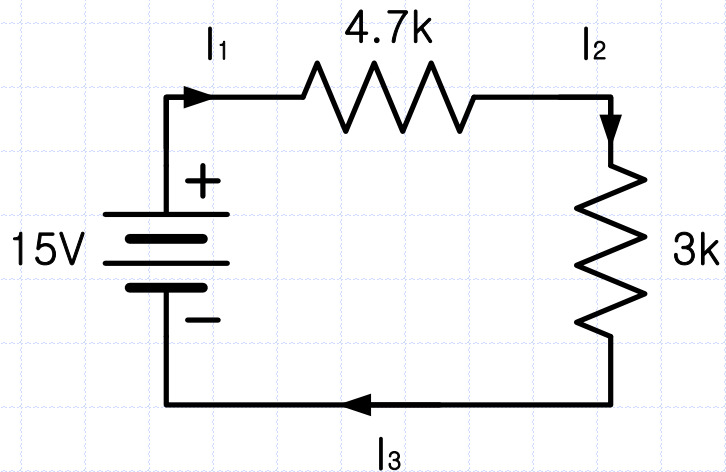
2-8A. 전류 측정



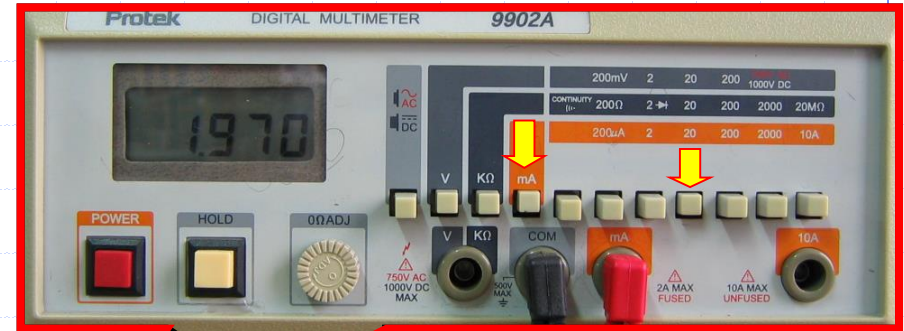
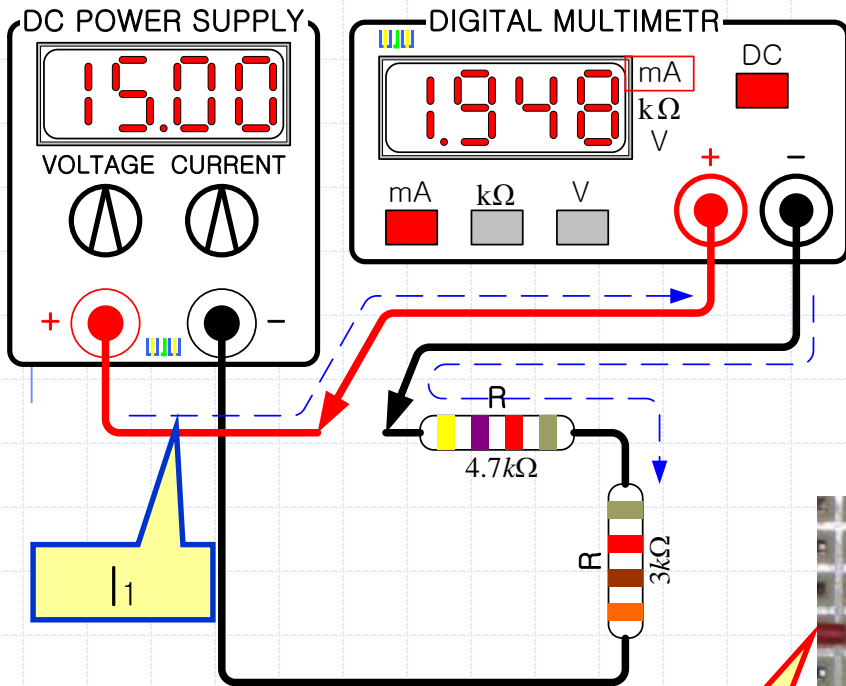
2-8A. 전류 측정



2-8B. 전류 측정

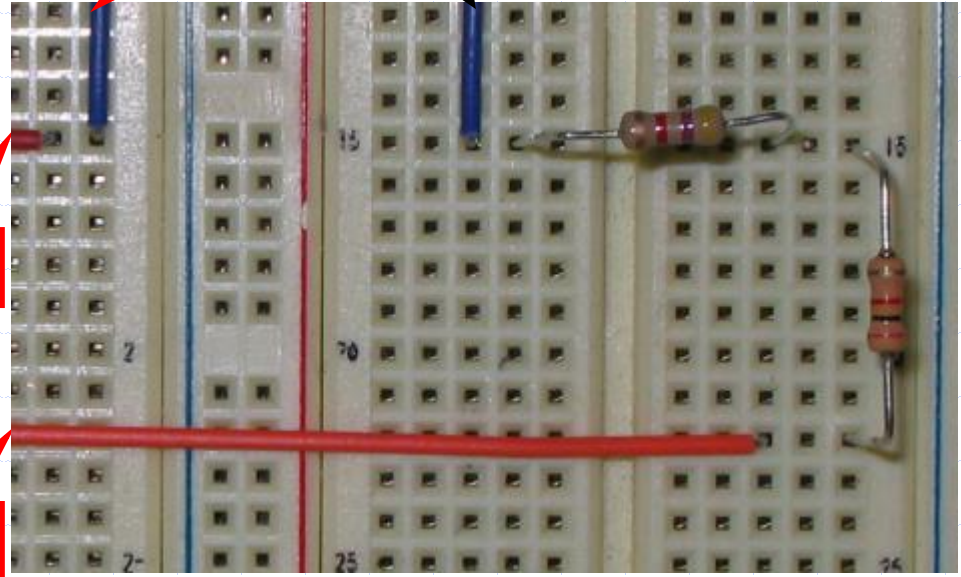


2-8B. 전류 측정

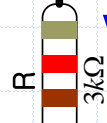
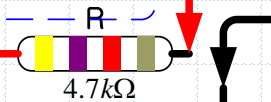
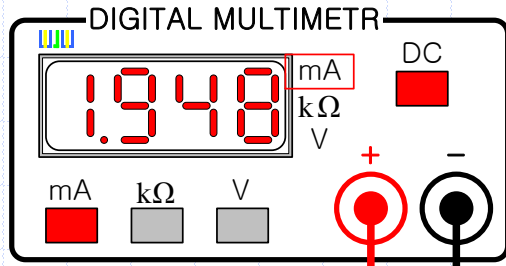
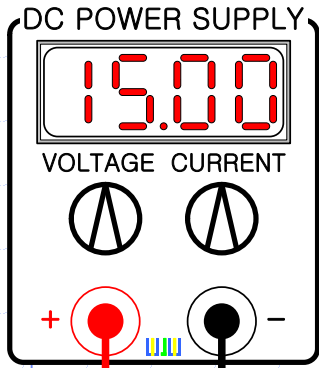


+15V

GND



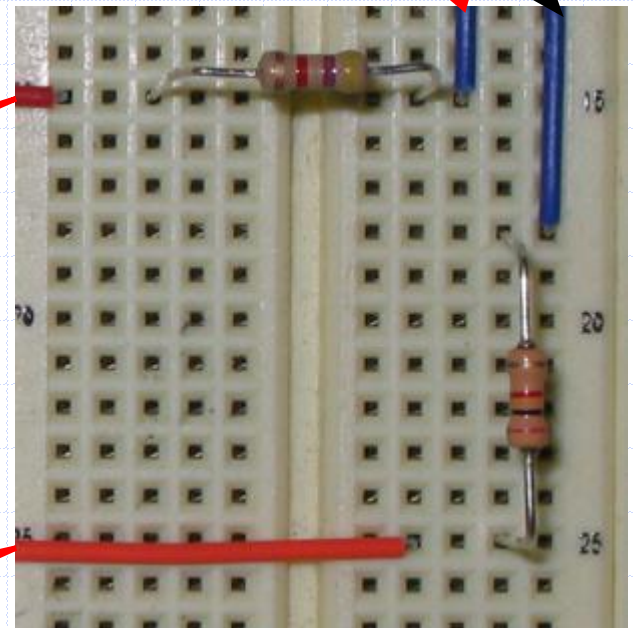
2-8B. 전류 측정



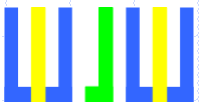
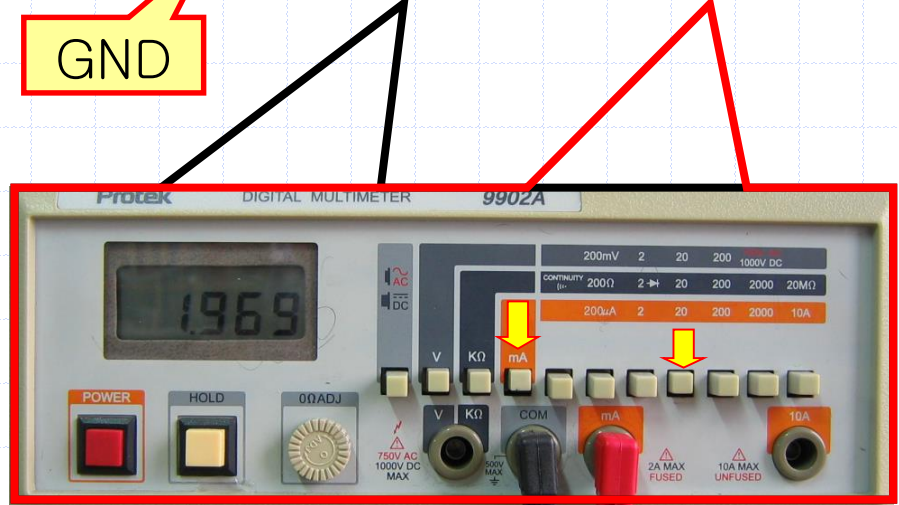
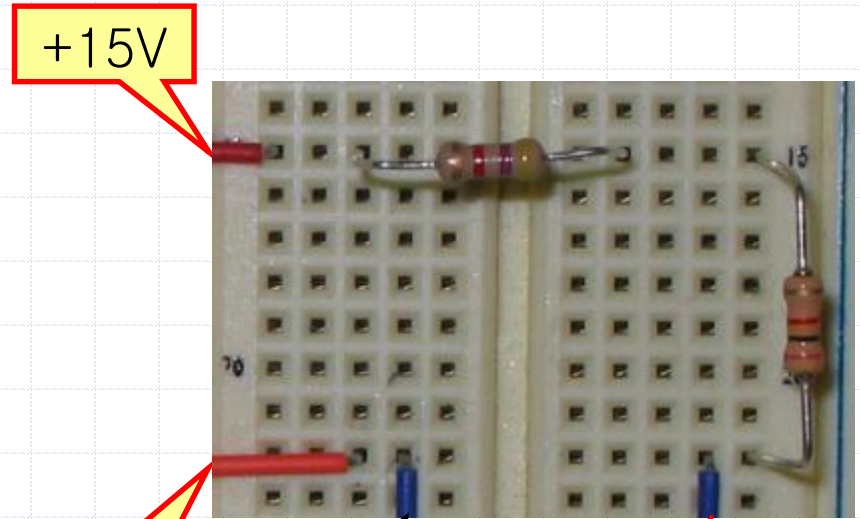
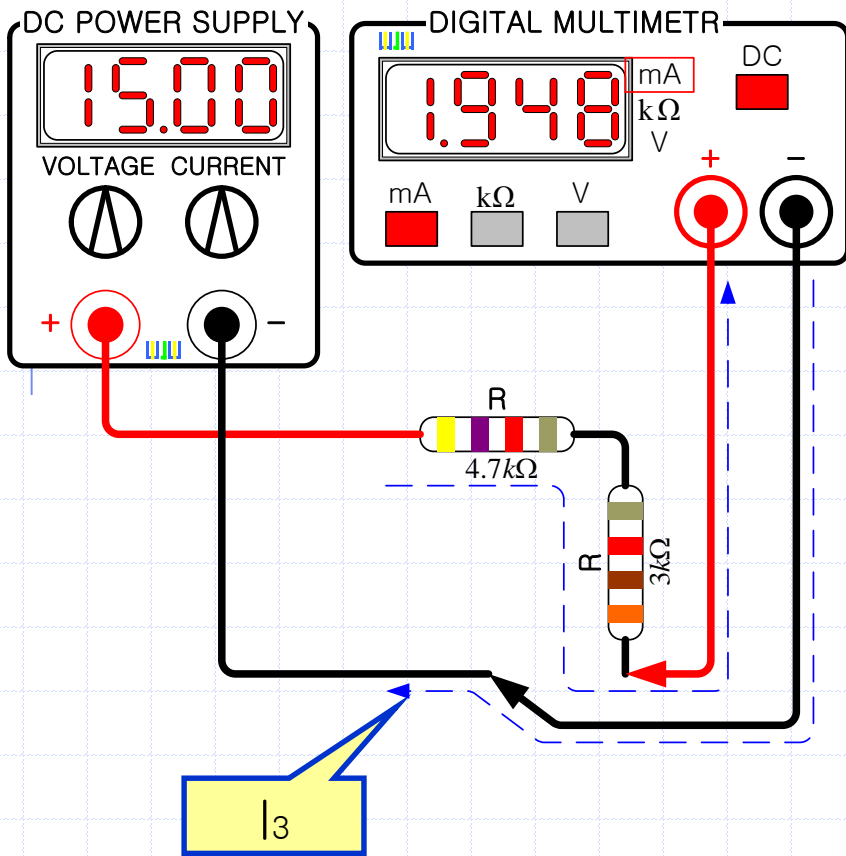
I_2

+15V

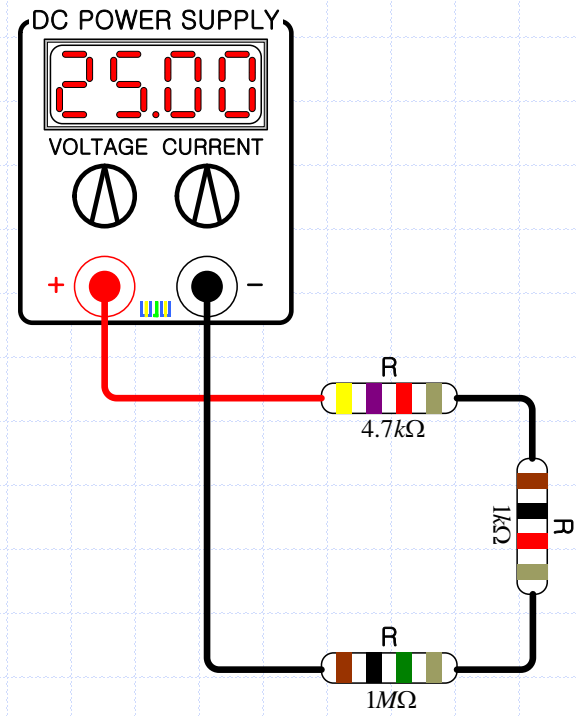
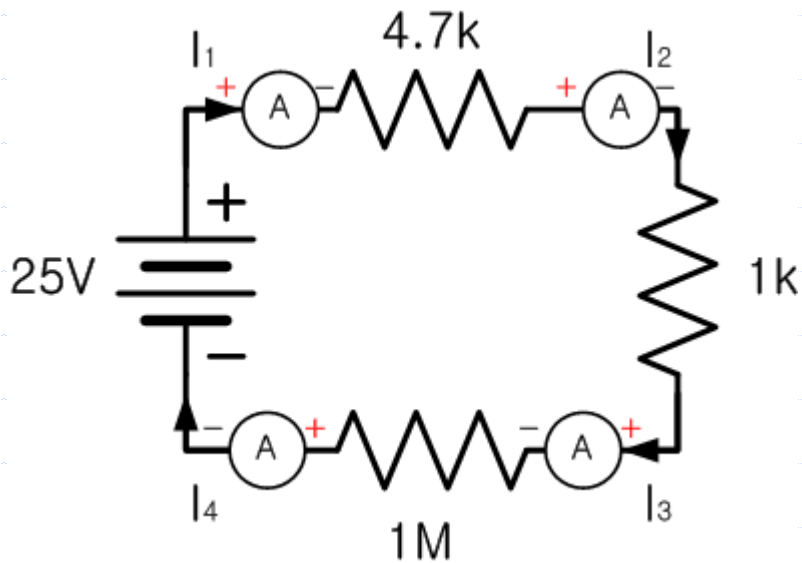
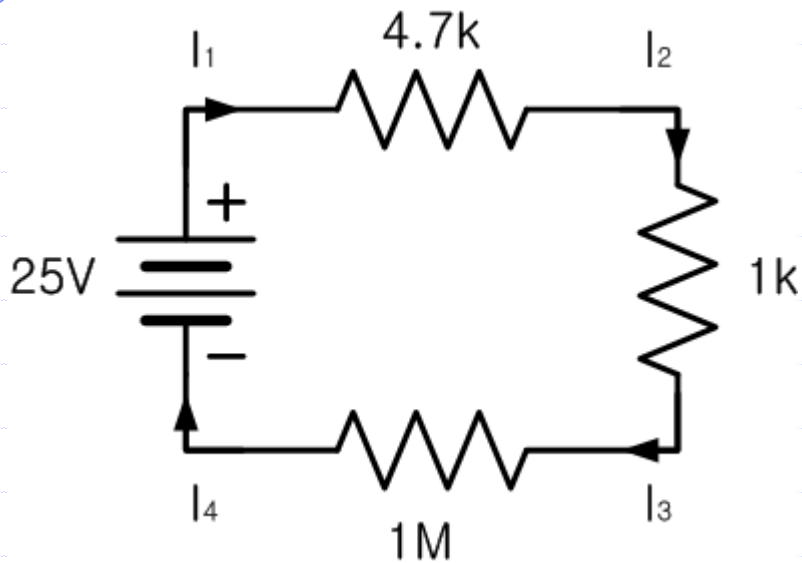
GND



2-8B. 전류 측정

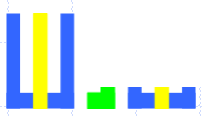
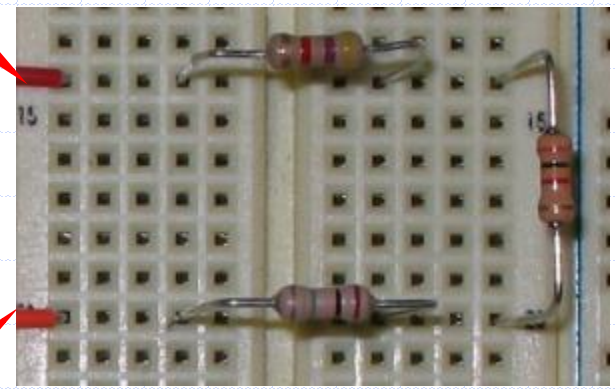


2-8C. 전류 측정

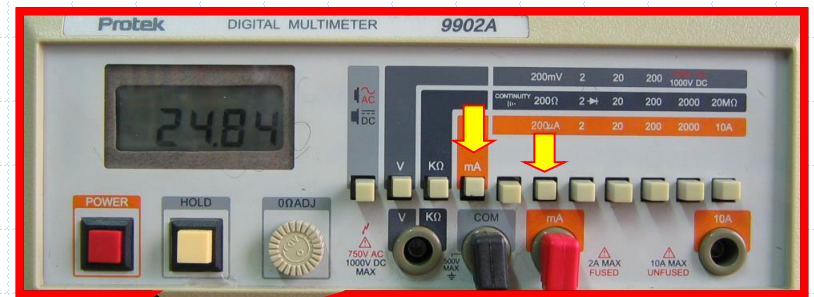
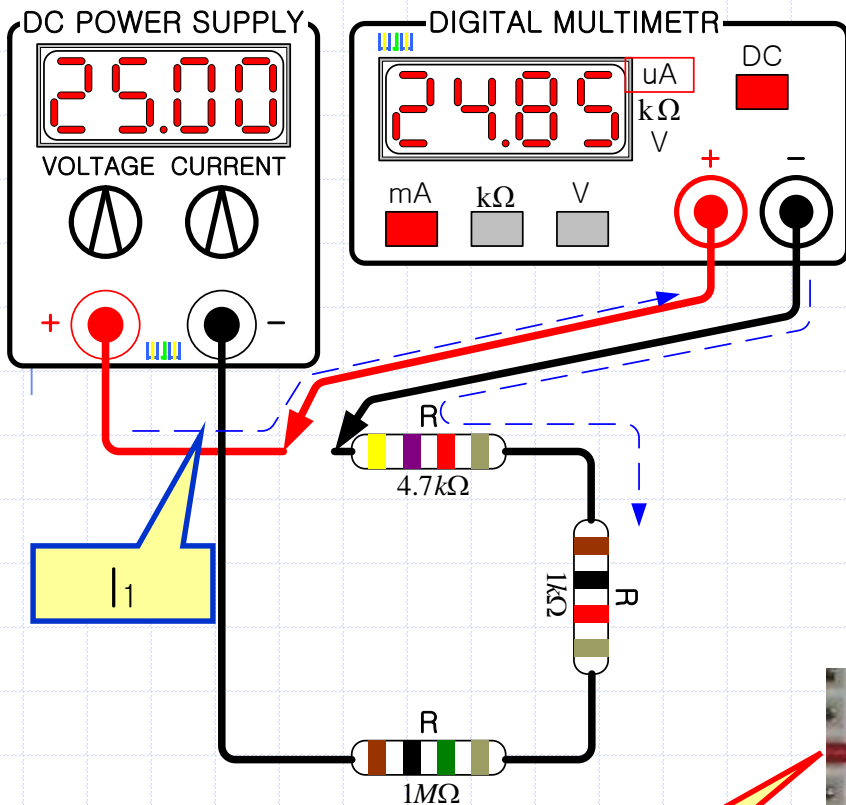


+25V

GND

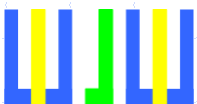
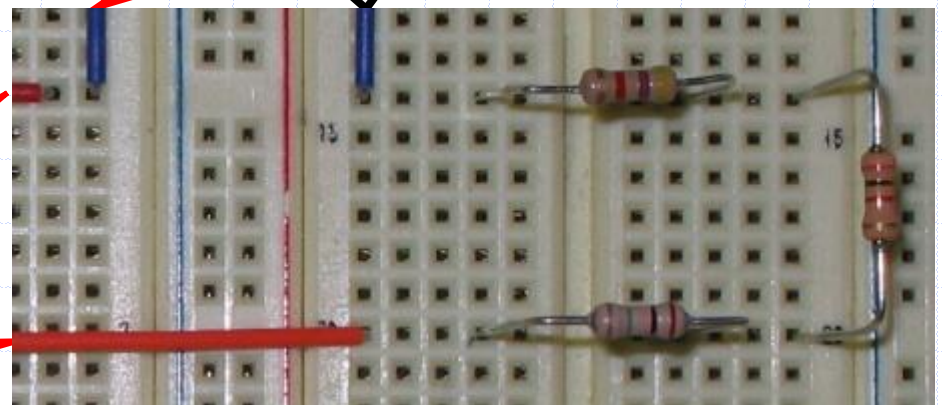


2-8C. 전류 측정

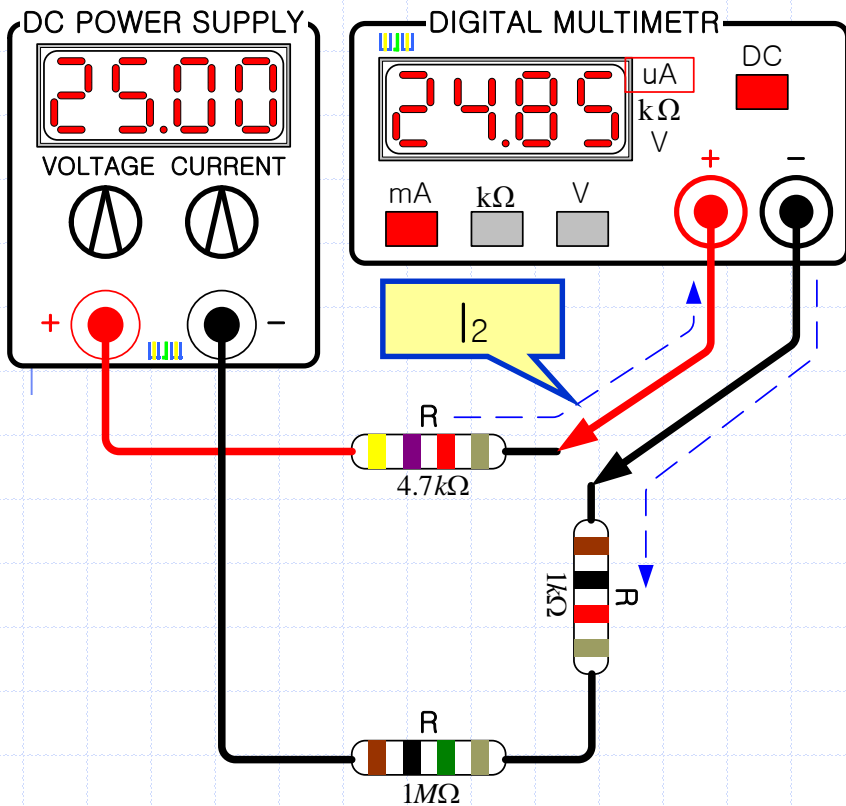


+25V

GND

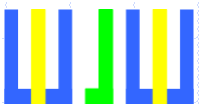
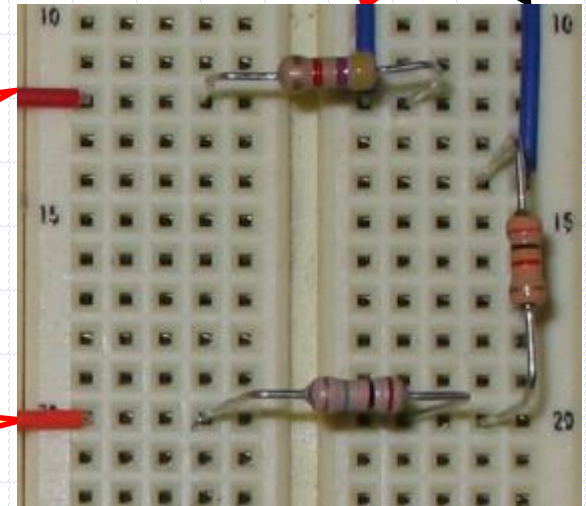


2-8C. 전류 측정

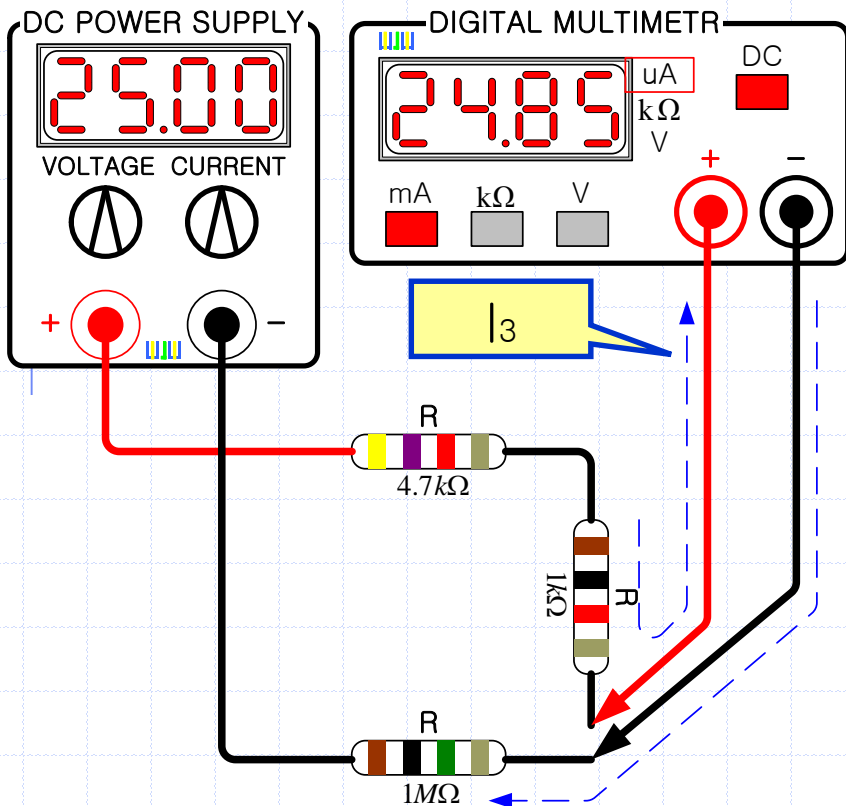


+25V

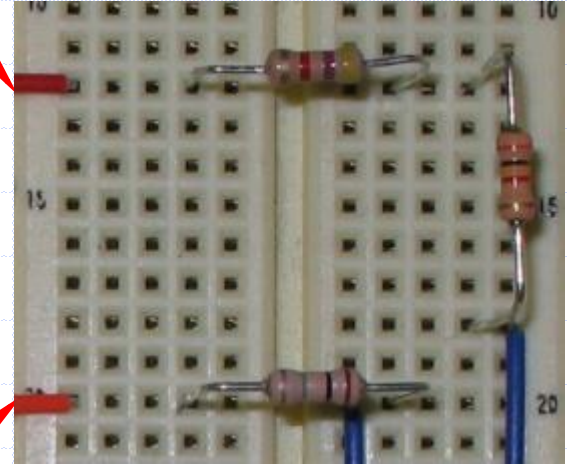
GND



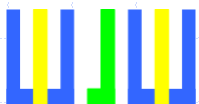
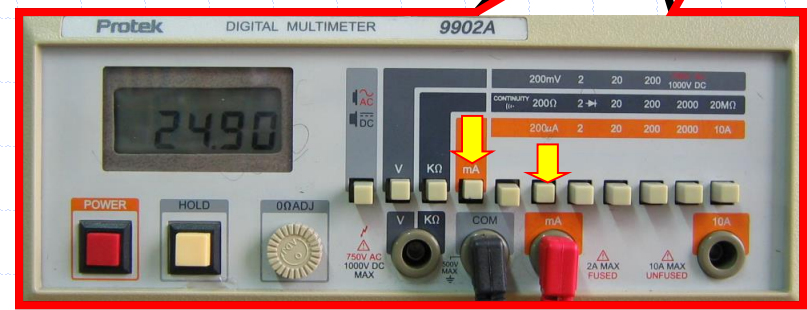
2-8C. 전류 측정



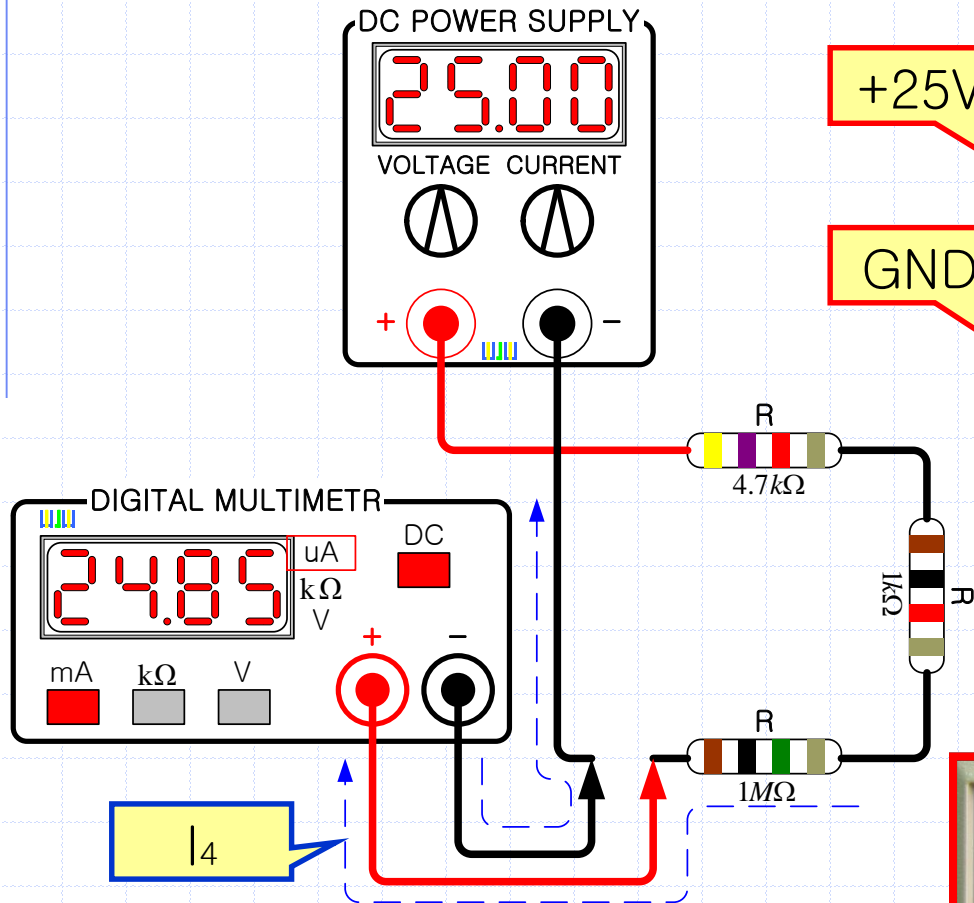
+25V



GND

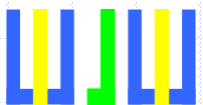
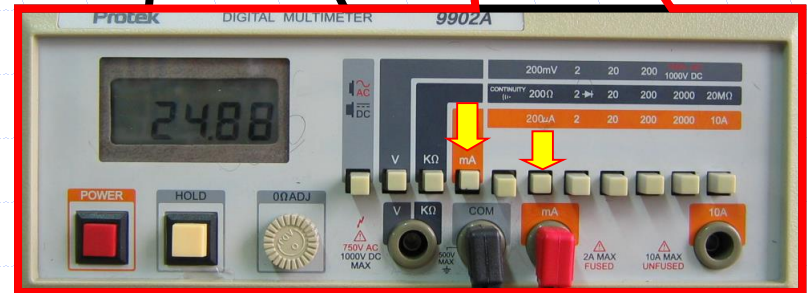
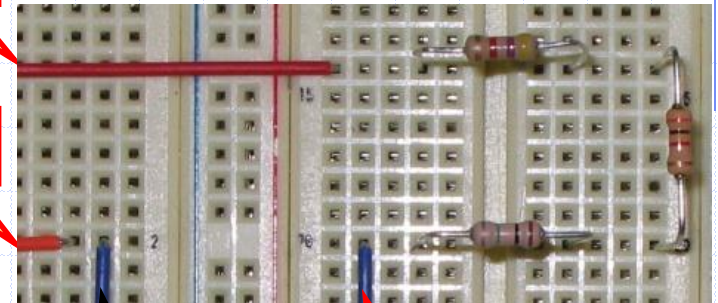


2-8C. 전류 측정



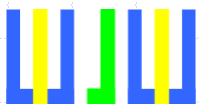
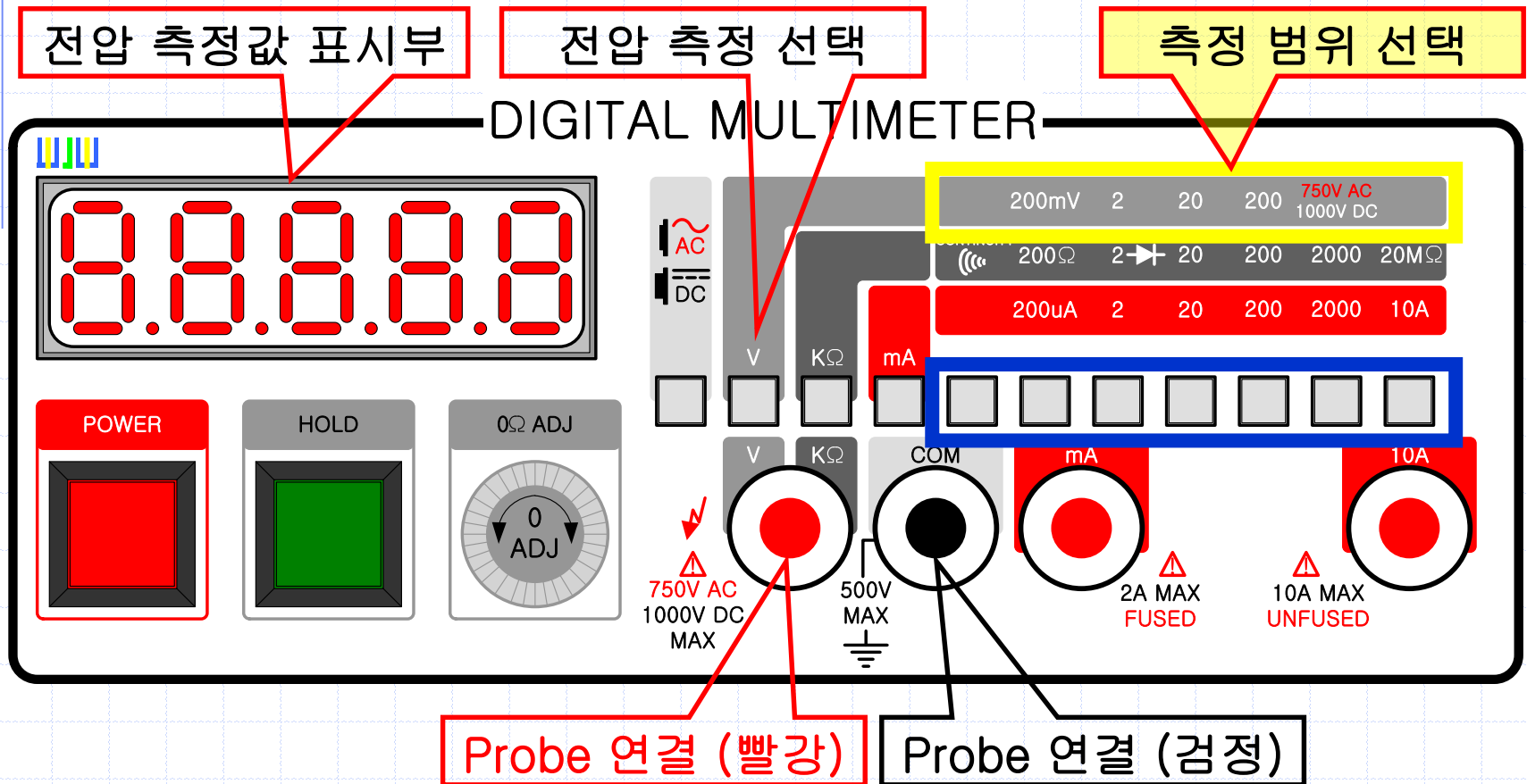
+25V

GND



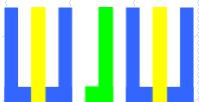
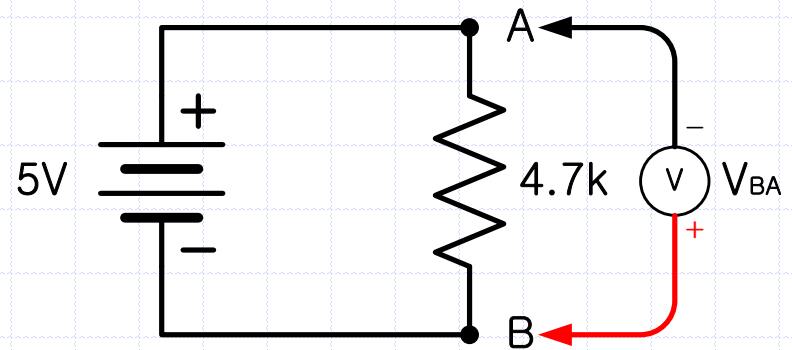
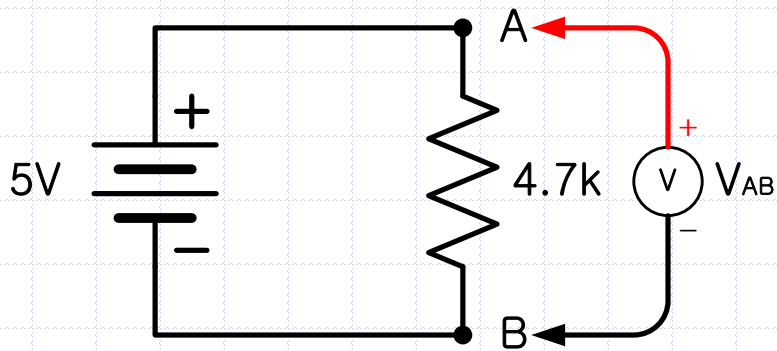
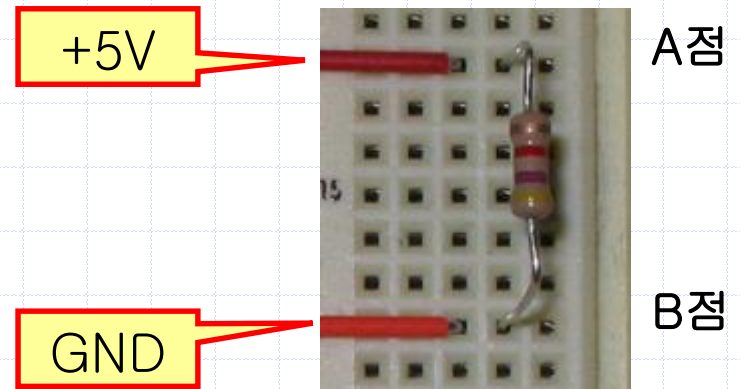
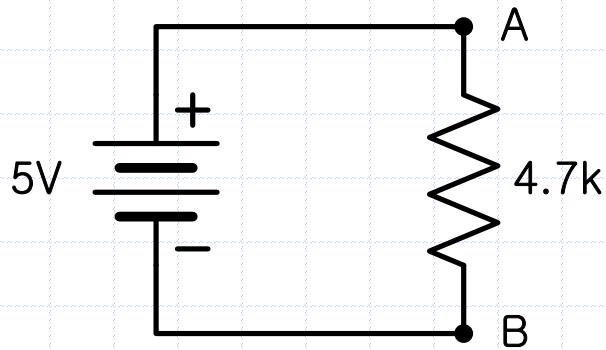
2-9. 디지털 멀티미터 (DMM)-전압 측정

- ✓ DMM 사용하기 (전압 측정)

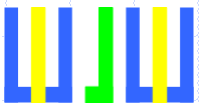
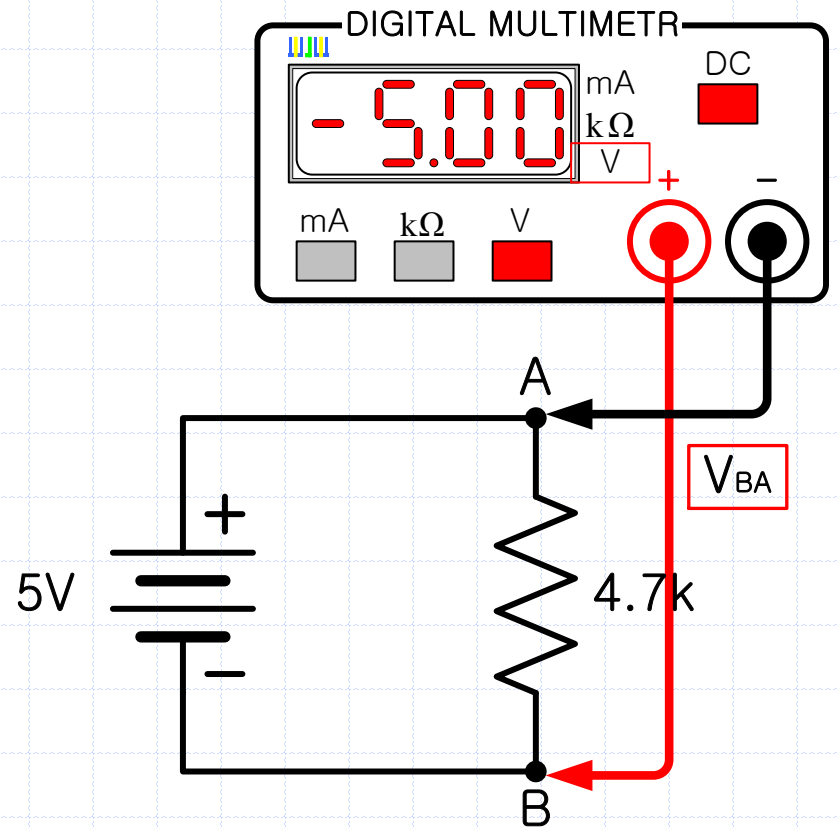
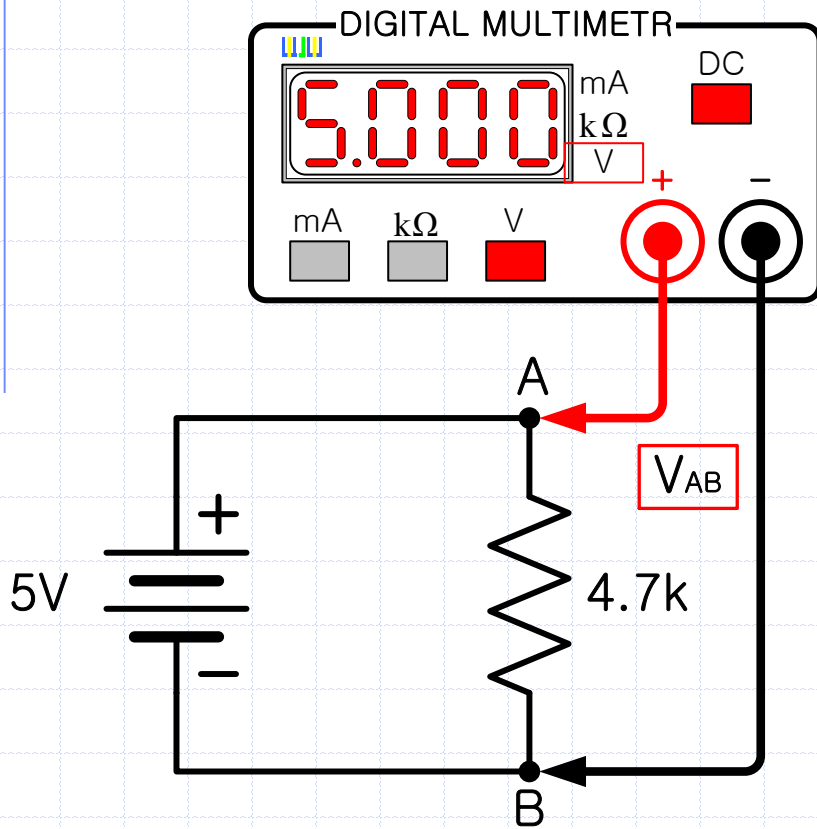


2-10A. 전압 측정

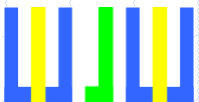
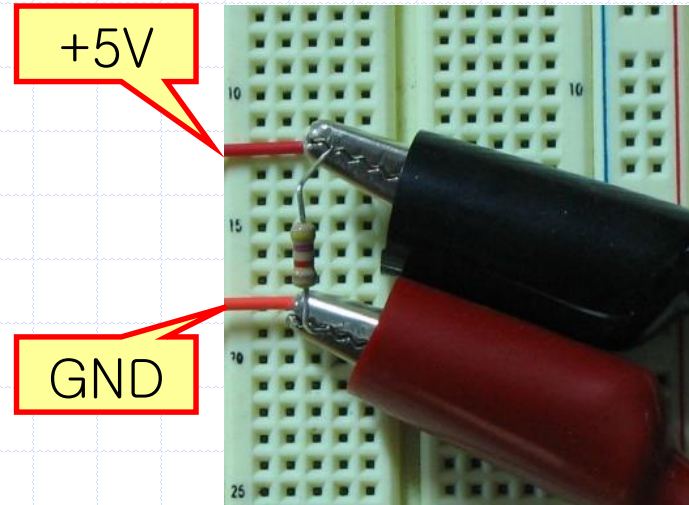
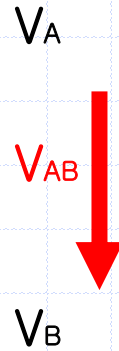
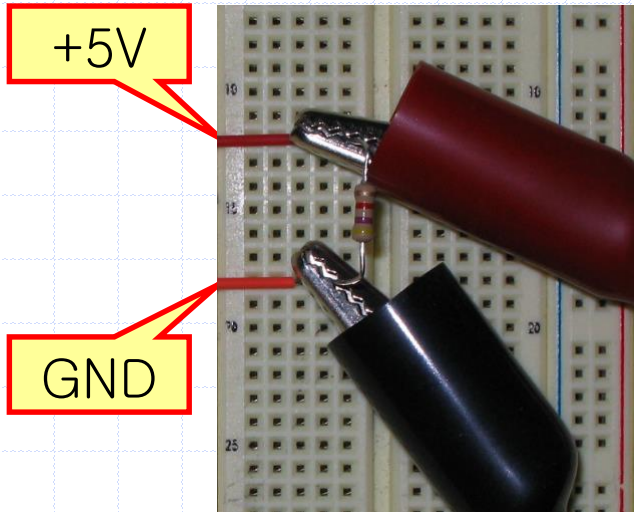
- ✓ 전압의 측정 방법 : 회로와 병렬로 연결하여 측정



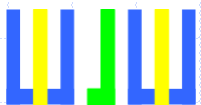
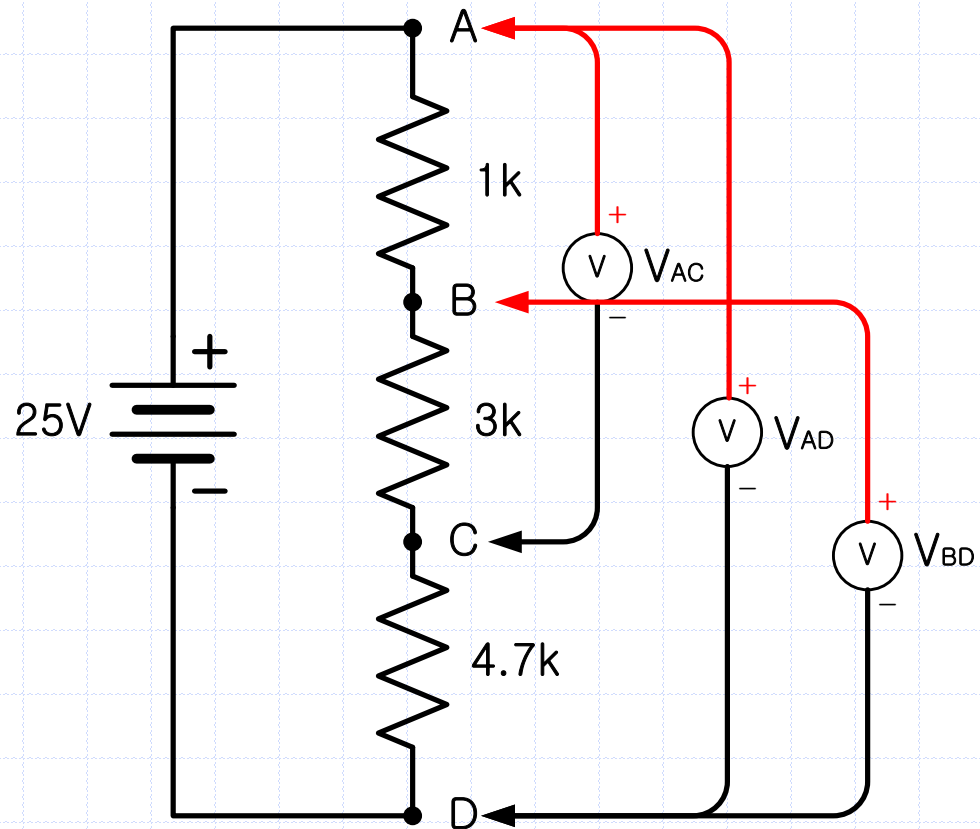
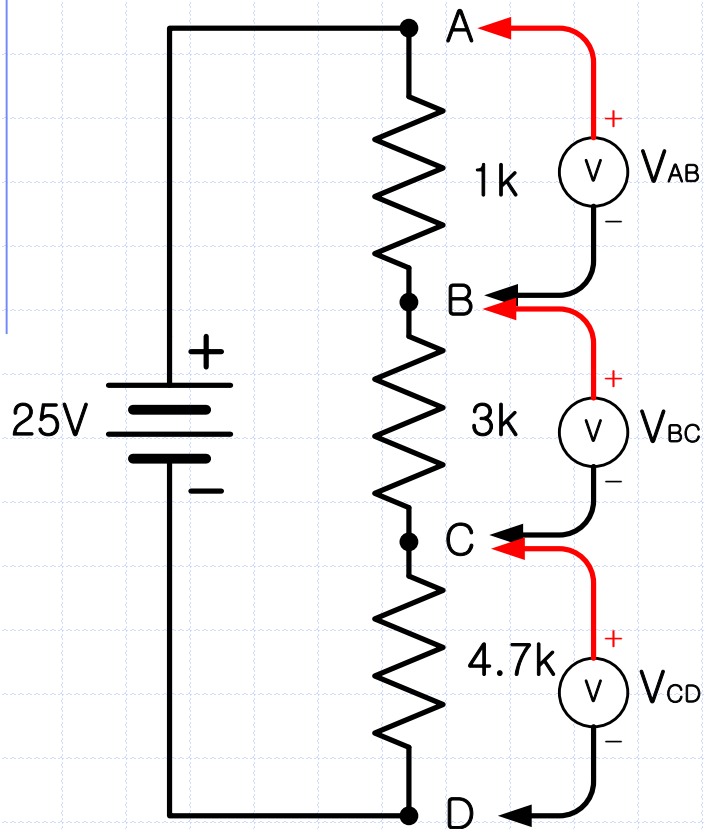
2-10A. 전압 측정



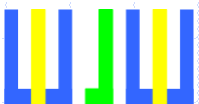
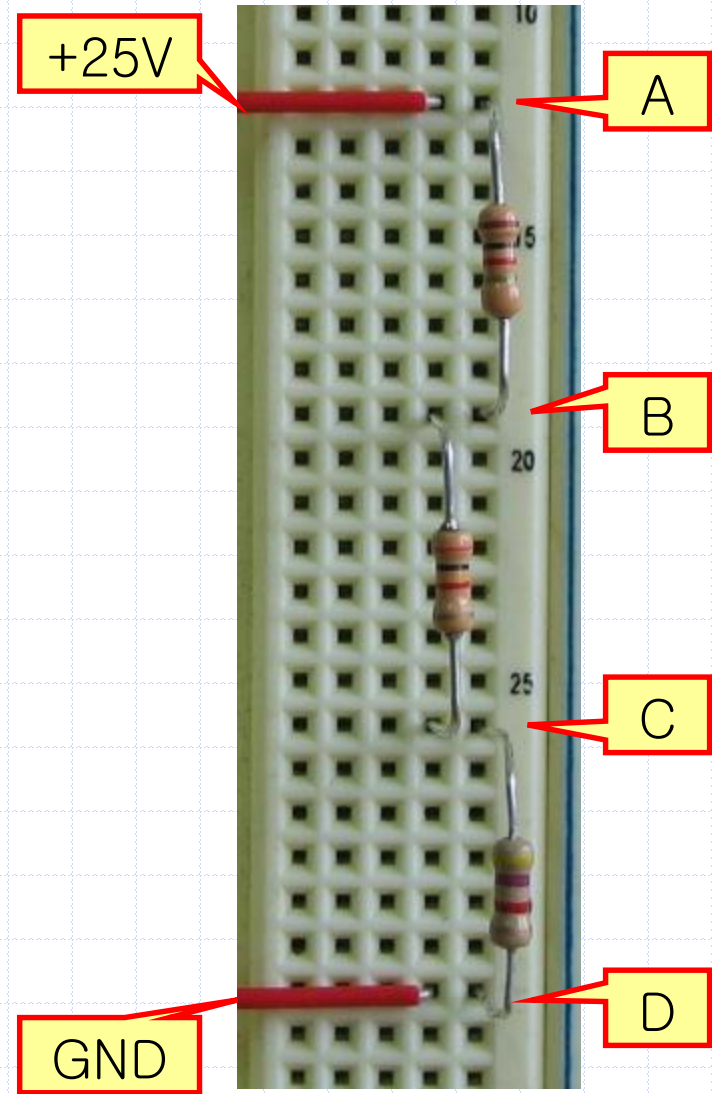
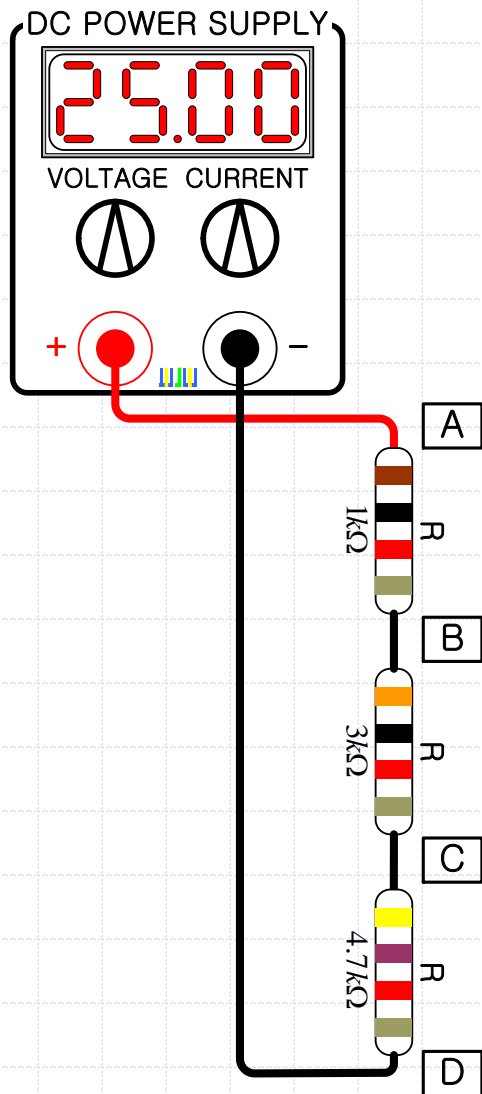
2-10A. 전압 측정



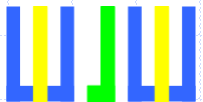
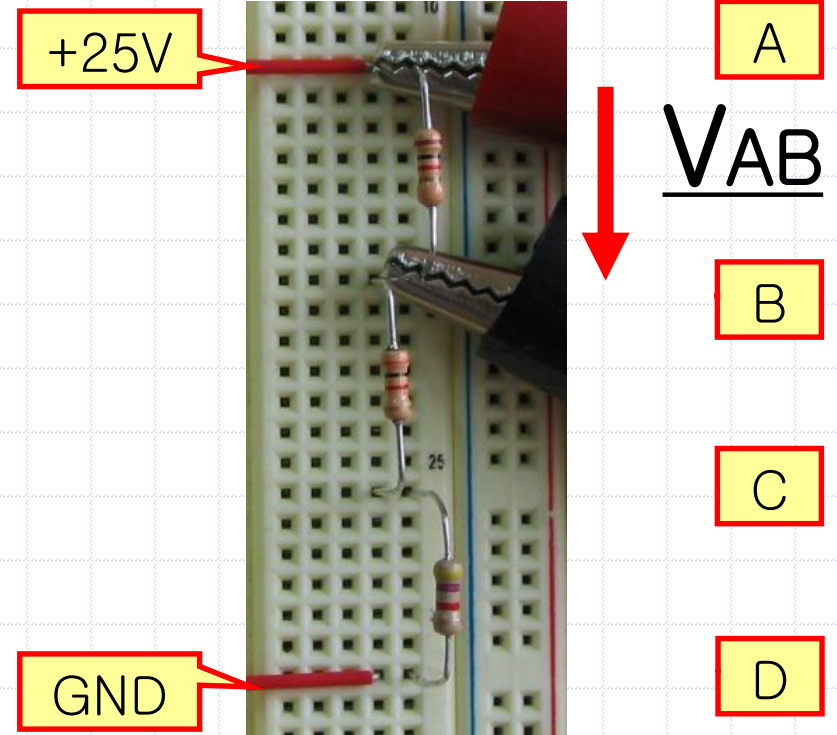
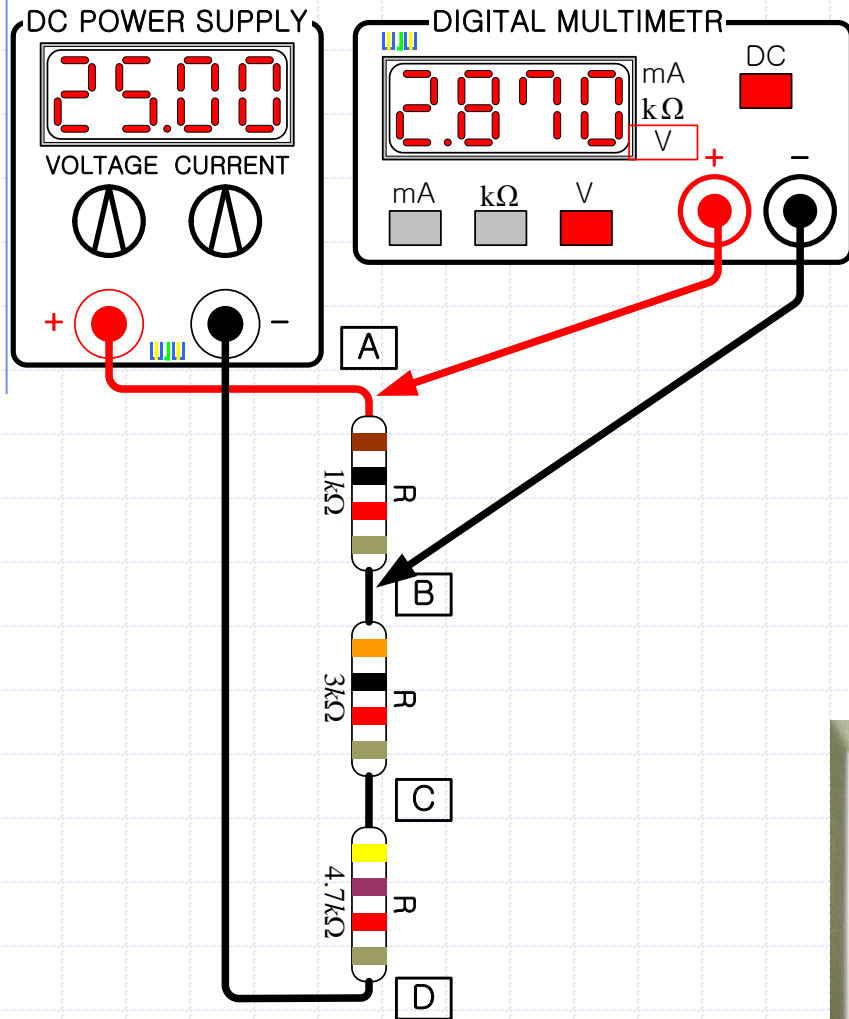
2-10B. 전압 측정



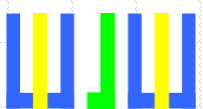
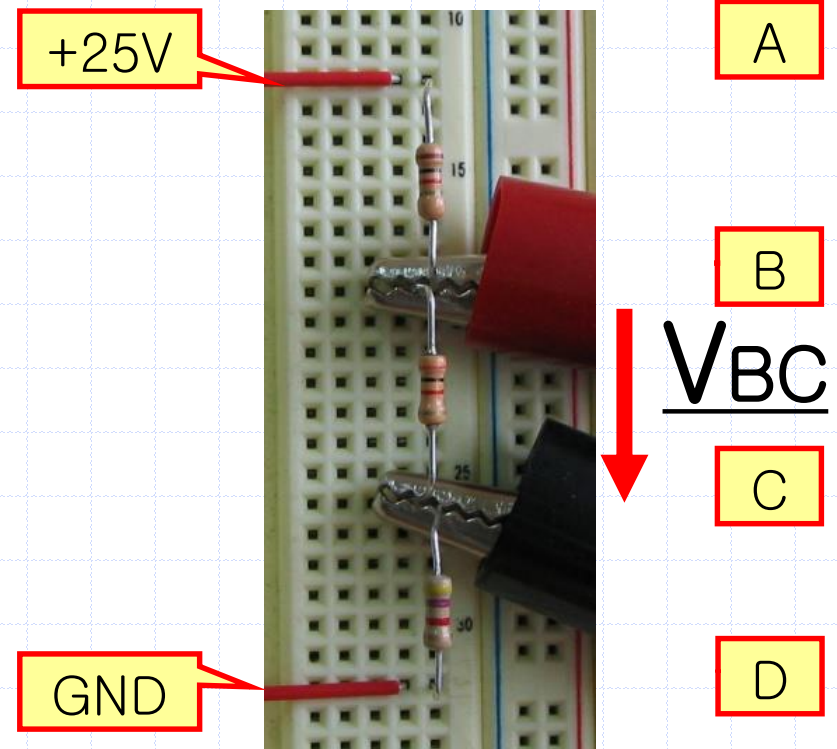
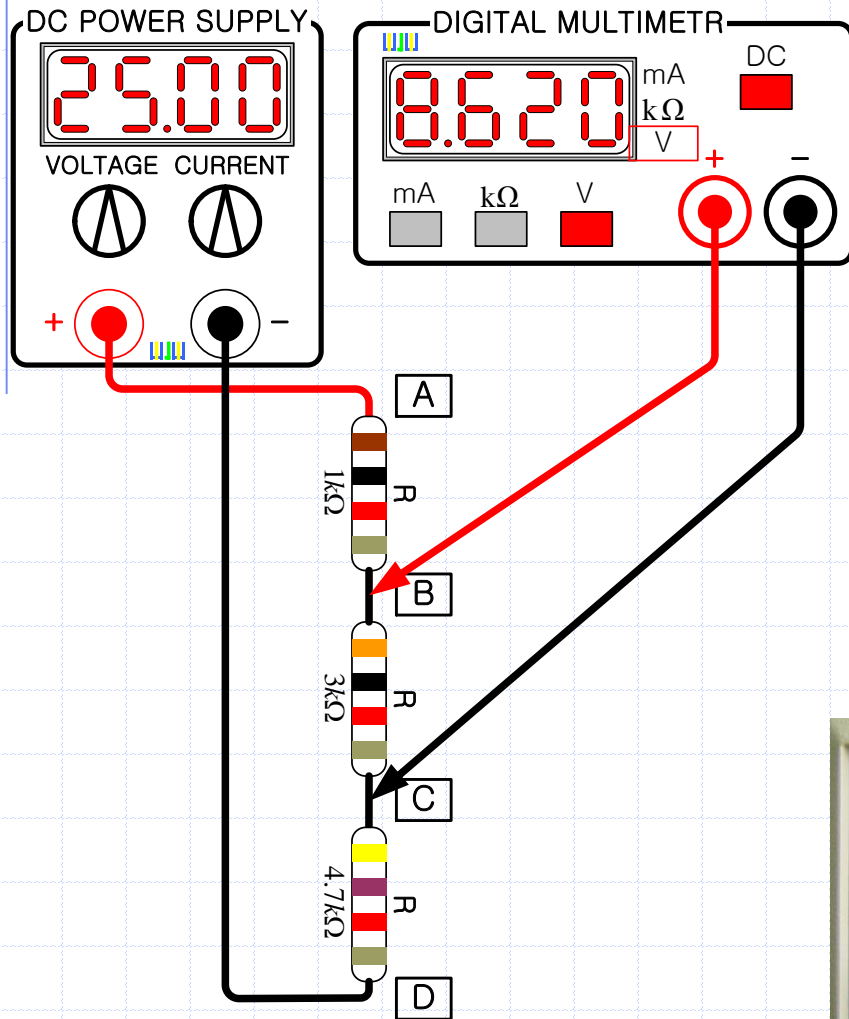
2-10B. 전압 측정



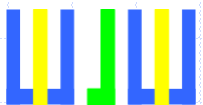
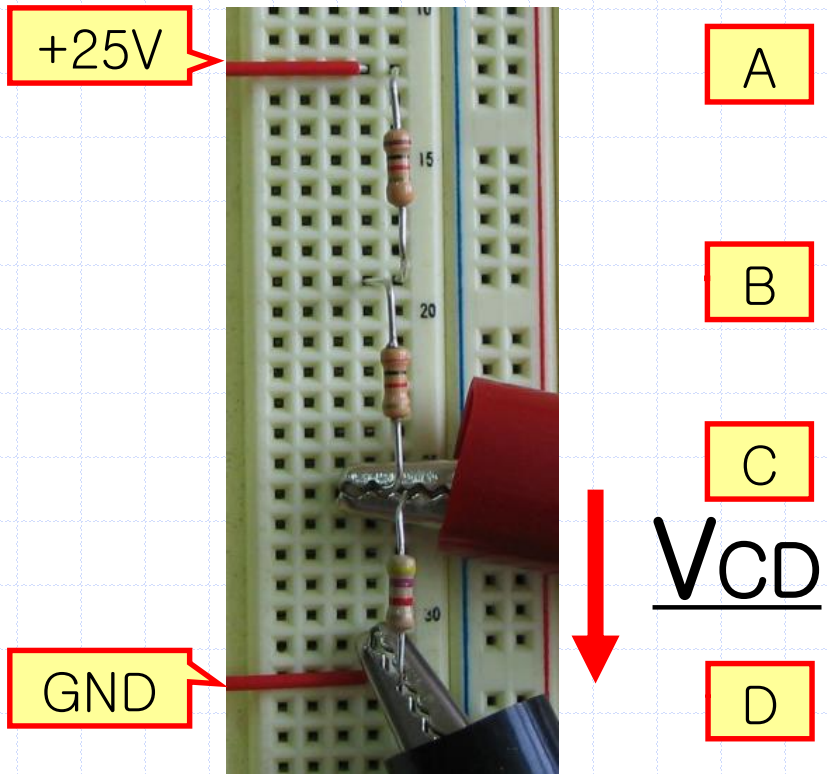
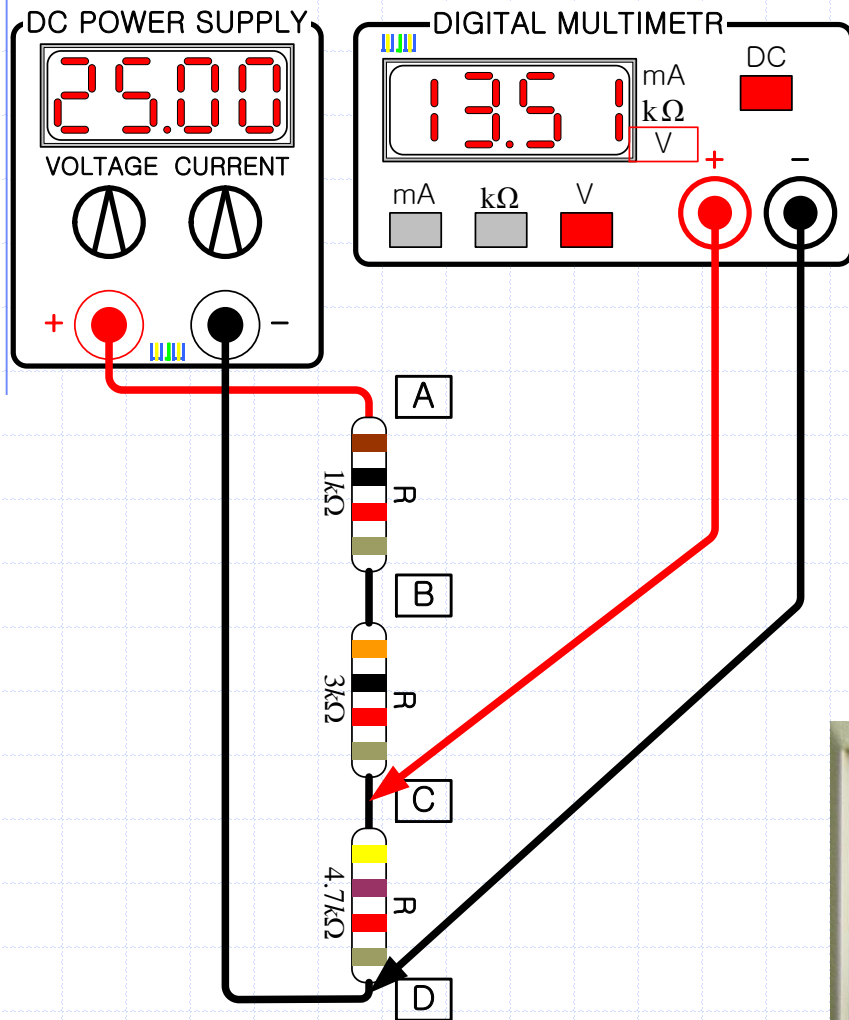
2-10B. 전압 측정



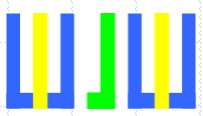
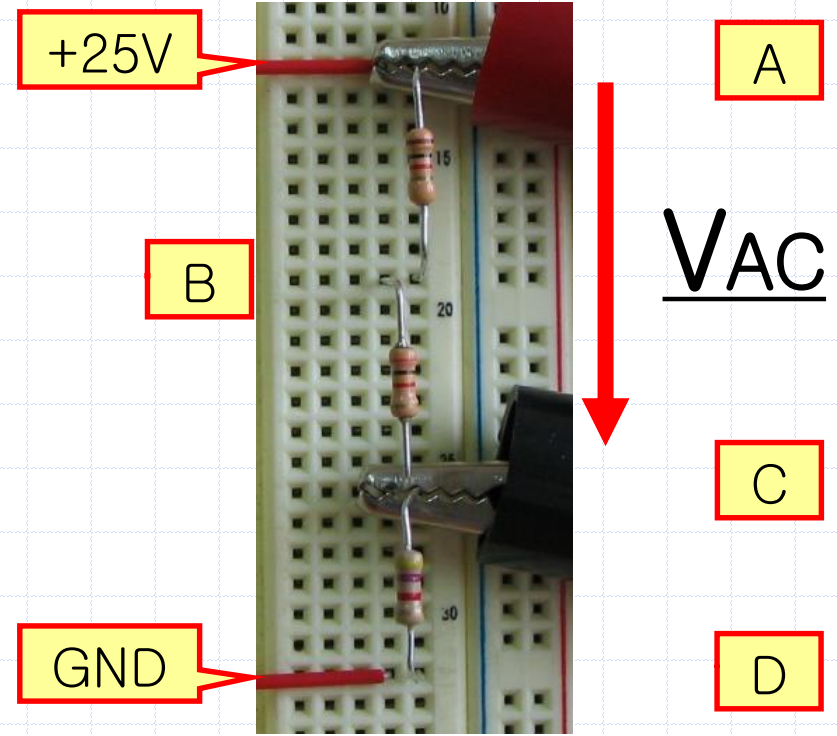
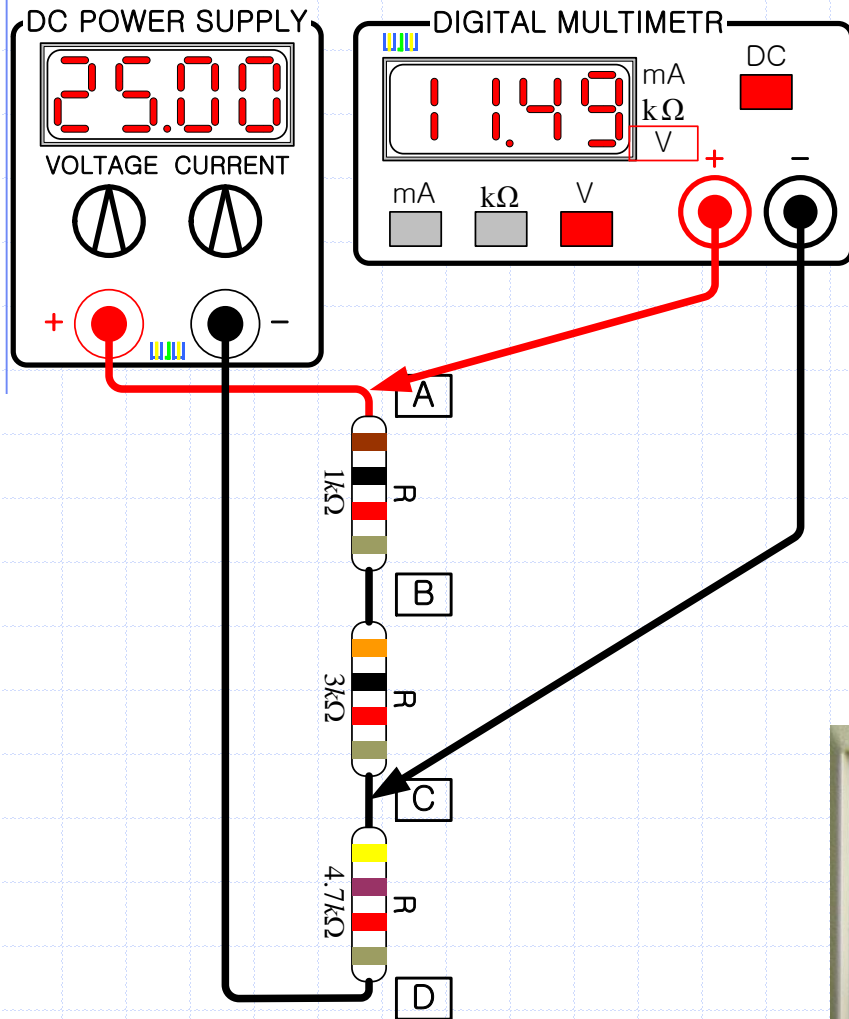
2-10B. 전압 측정



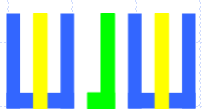
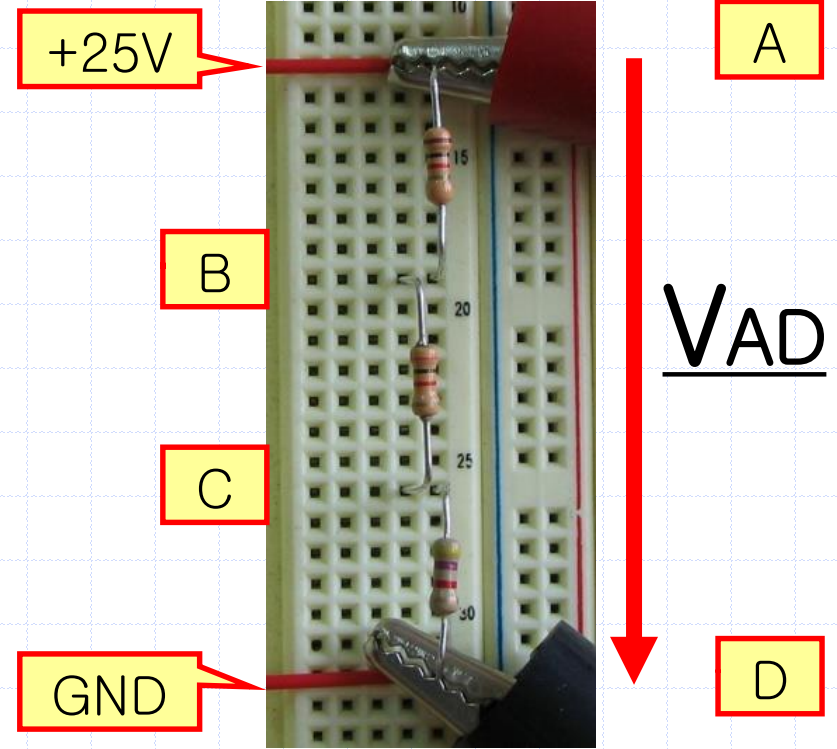
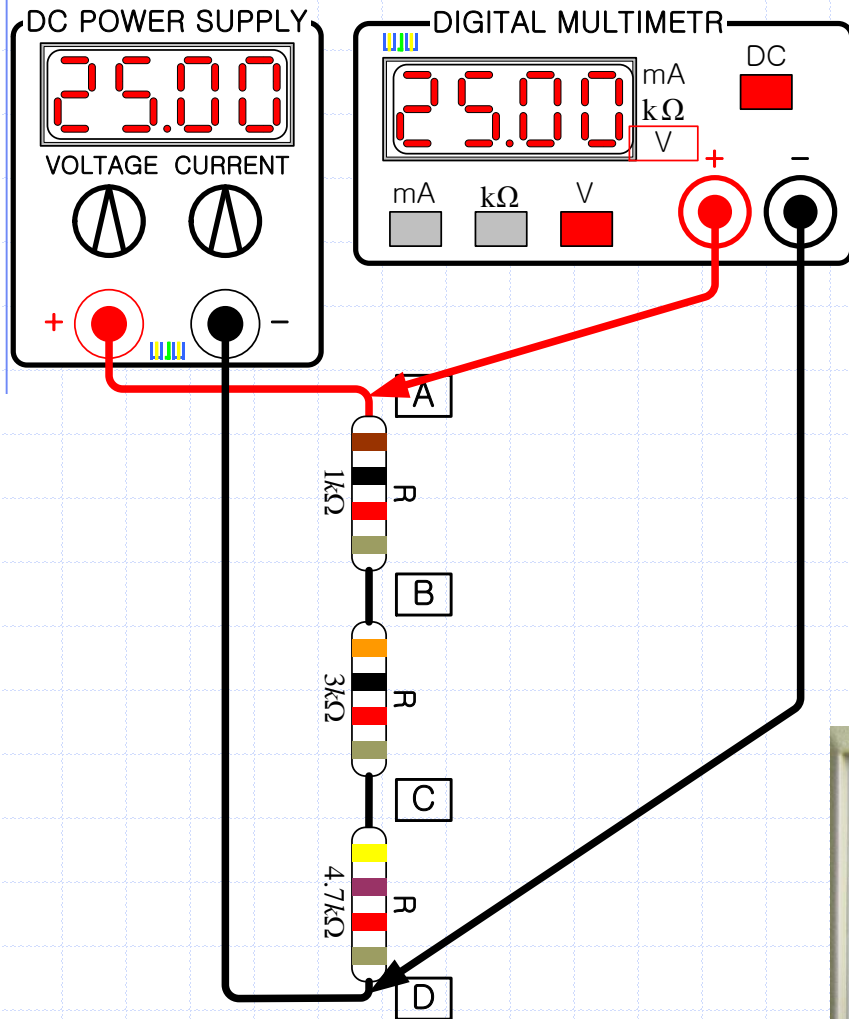
2-10B. 전압 측정



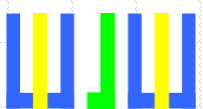
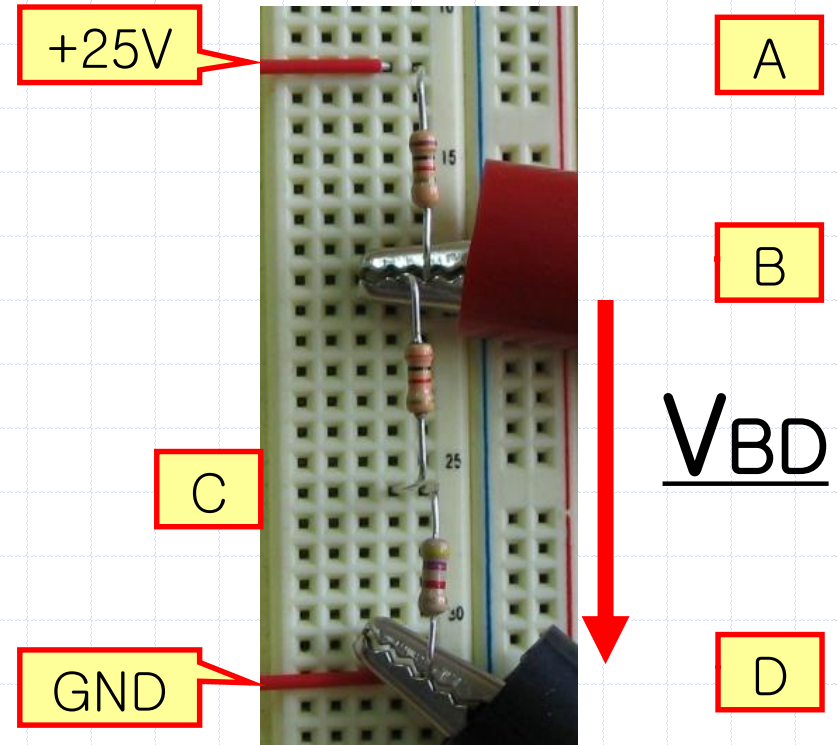
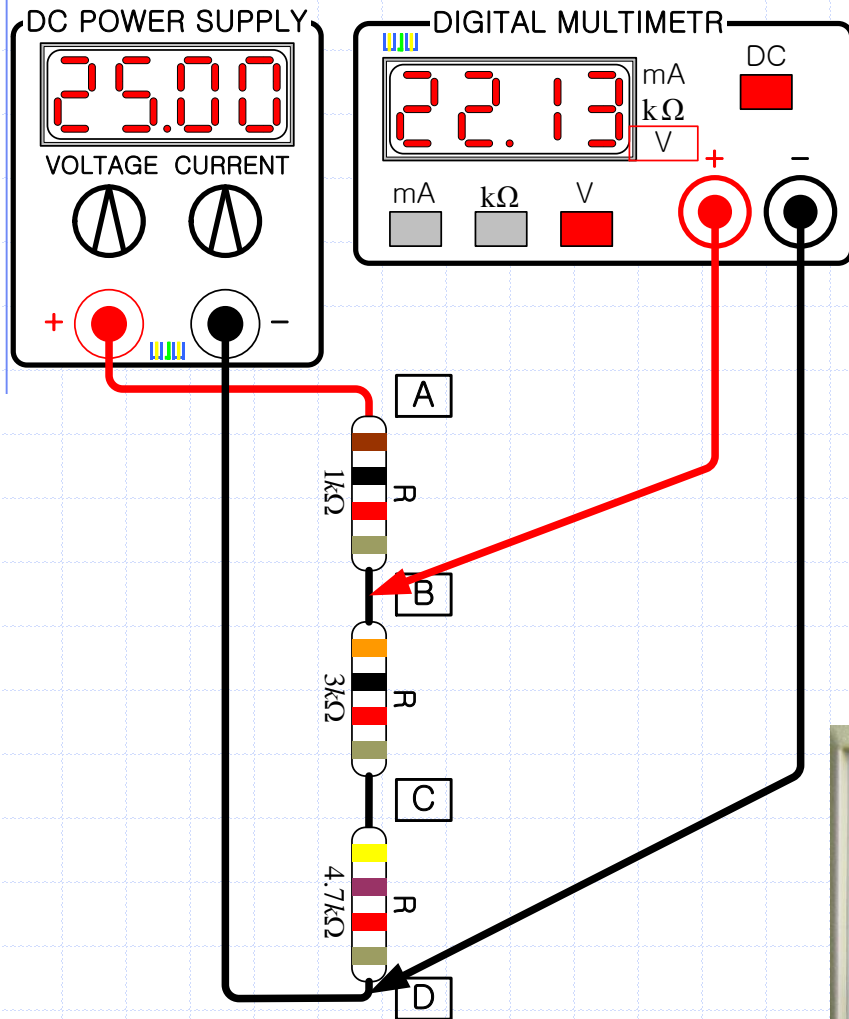
2-10B. 전압 측정



2-10B. 전압 측정



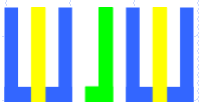
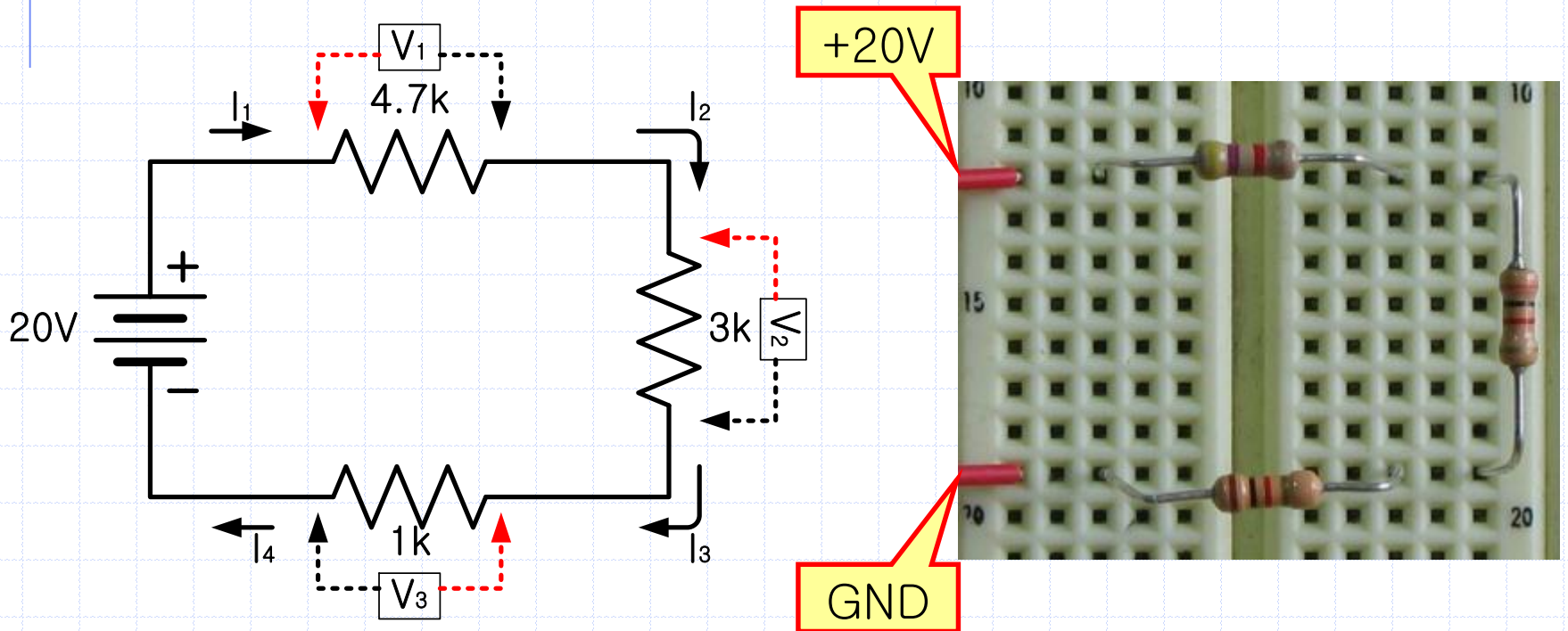
2-10B. 전압 측정



2-11A. 전류, 전압 측정 및 전력 계산

- ✓ 전력 계산 : 각 단의 전류와 전압을 측정하여 계산

$$P = VI = I^2R = \frac{V^2}{R}$$



2-11A. 전류, 전압 측정 및 전력 계산

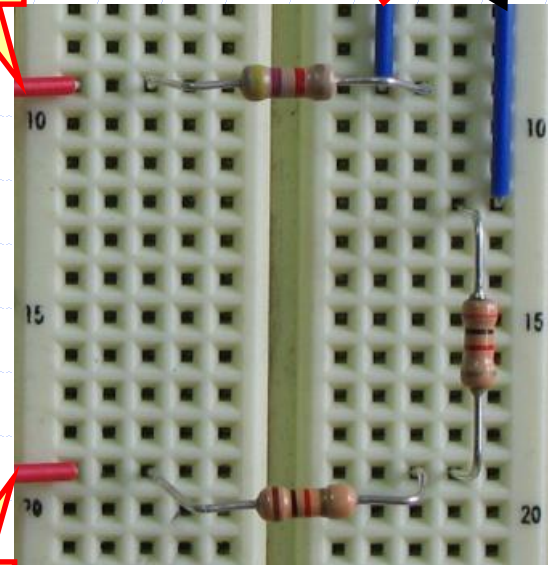
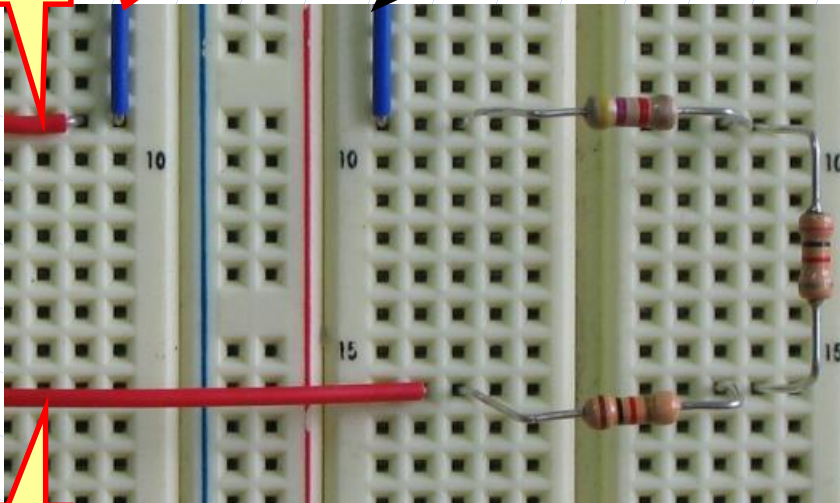


I₁

I₂

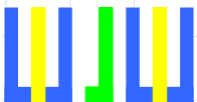
+20V

+20V

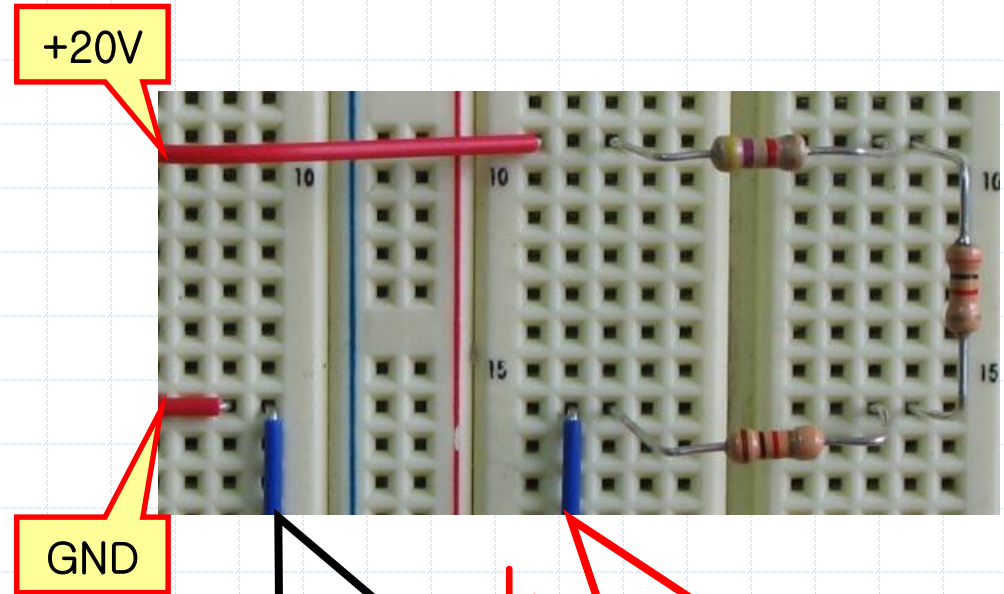
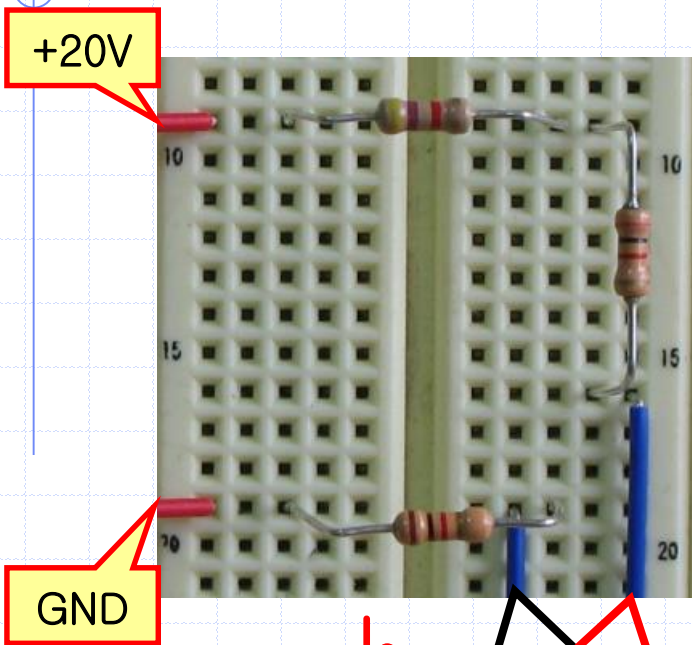


GND

GND

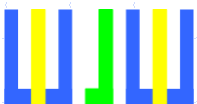


2-11A. 전류, 전압 측정 및 전력 계산

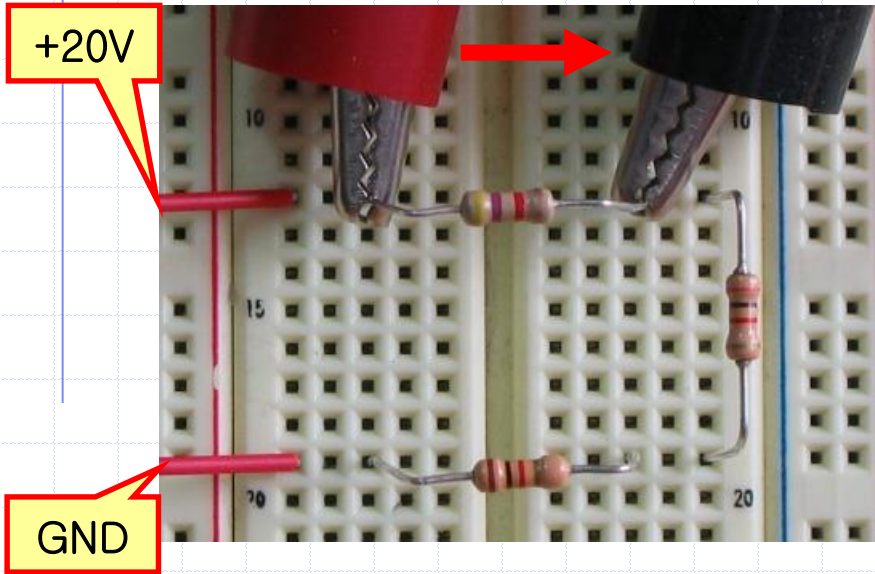


I₃

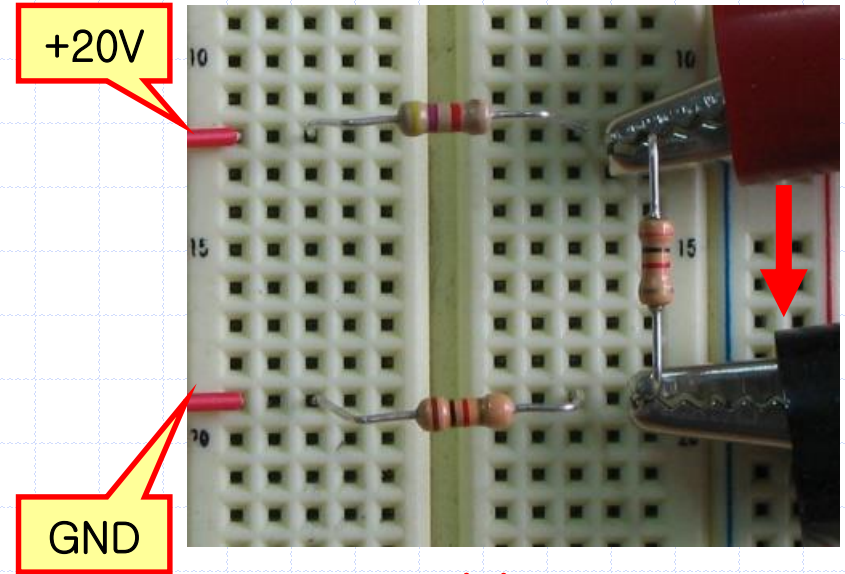
I₄



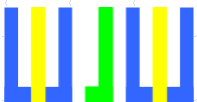
2-11A. 전류, 전압 측정 및 전력 계산



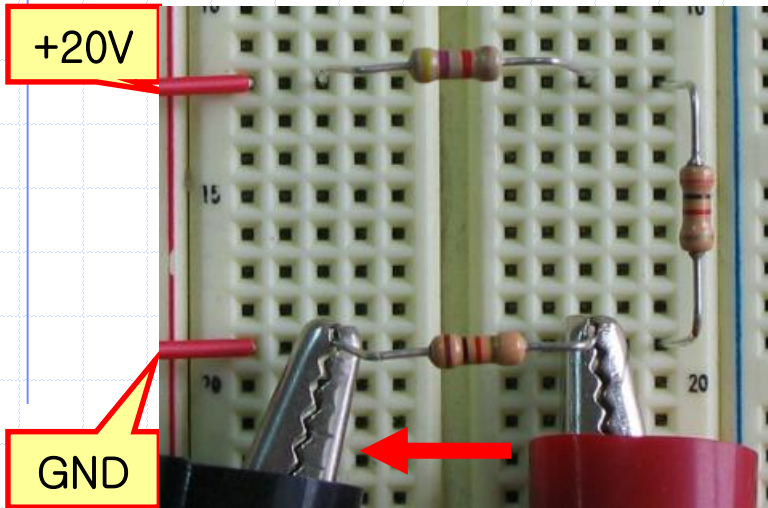
V₁



V₂



2-11A. 전류, 전압 측정 및 전력 계산



V₃

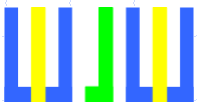


전력 계산

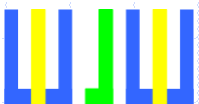
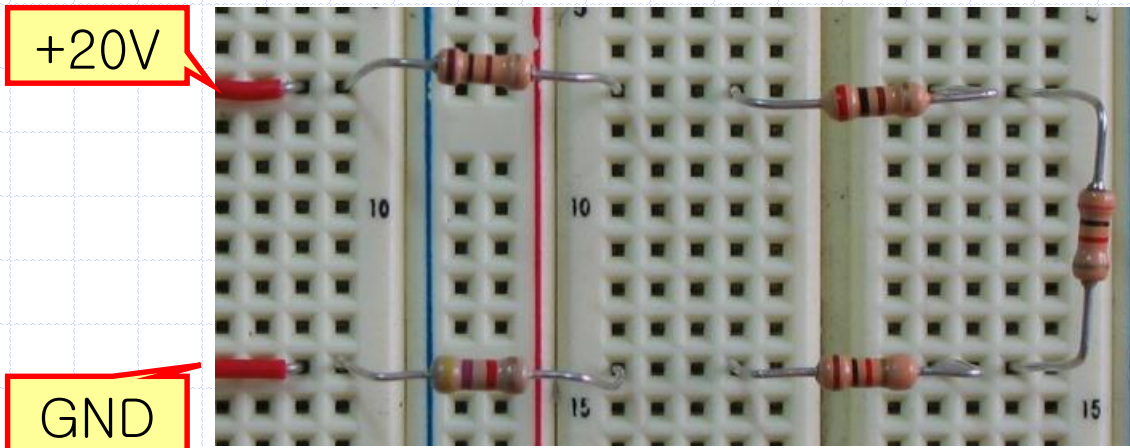
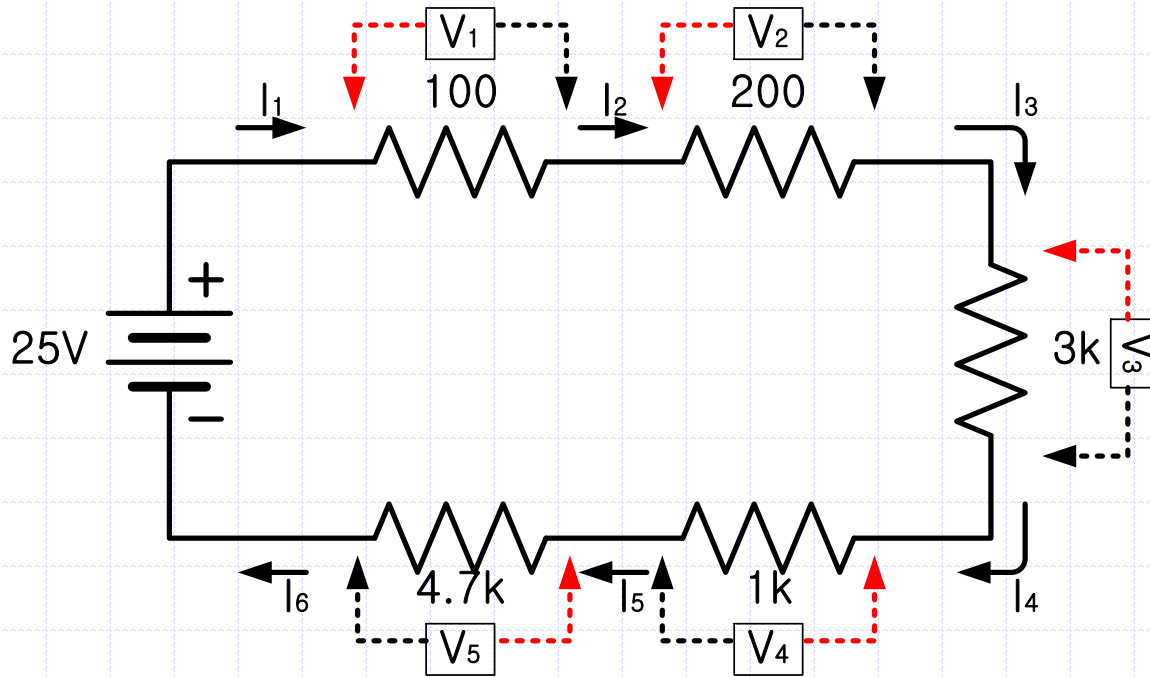
I_1	2.3 mA	V_1	10.8 V
P_1	$= I_1 \times V_1 = 24.84 \text{ mW}$		

I_2	2.3 mA	V_2	6.9 V
P_2	$= I_2 \times V_2 = 15.87 \text{ mW}$		

I_3	2.3 mA	V_3	2.3 V
P_3	$= I_3 \times V_3 = 5.29 \text{ mW}$		



2-11B. 전류, 전압 측정 및 전력 계산

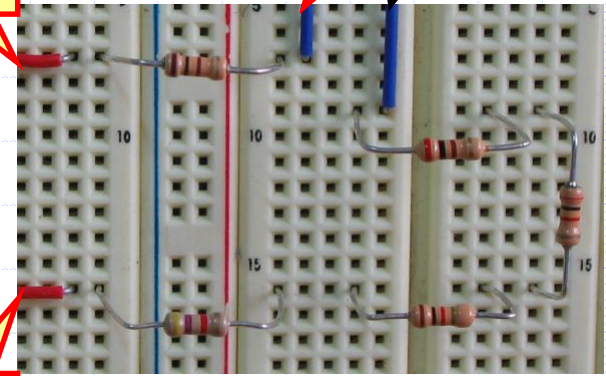
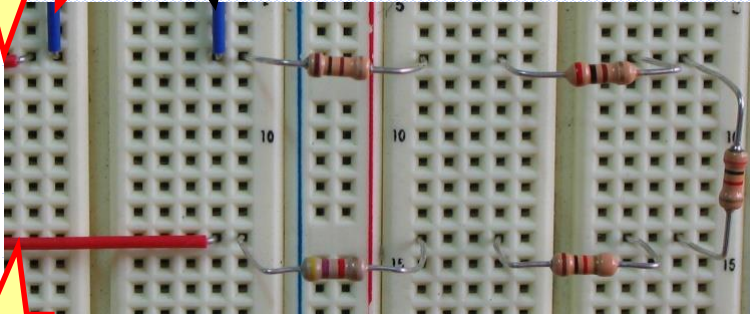


2-11B. 전류, 전압 측정 및 전력 계산



+20V

+20V

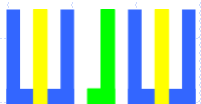


GND

GND

I₁

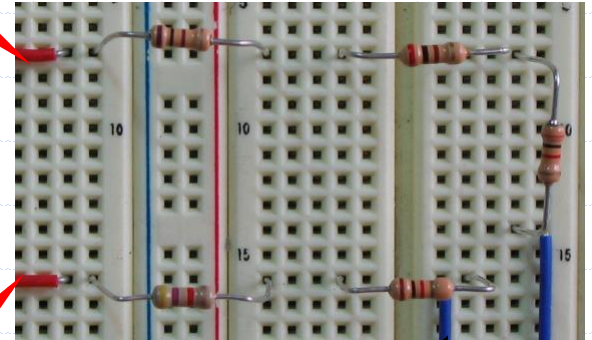
I₂



2-11B. 전류, 전압 측정 및 전력 계산

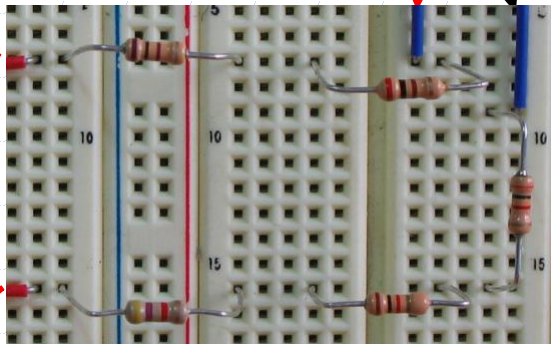


+20V



GND

+20V

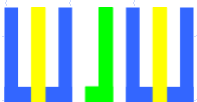


GND

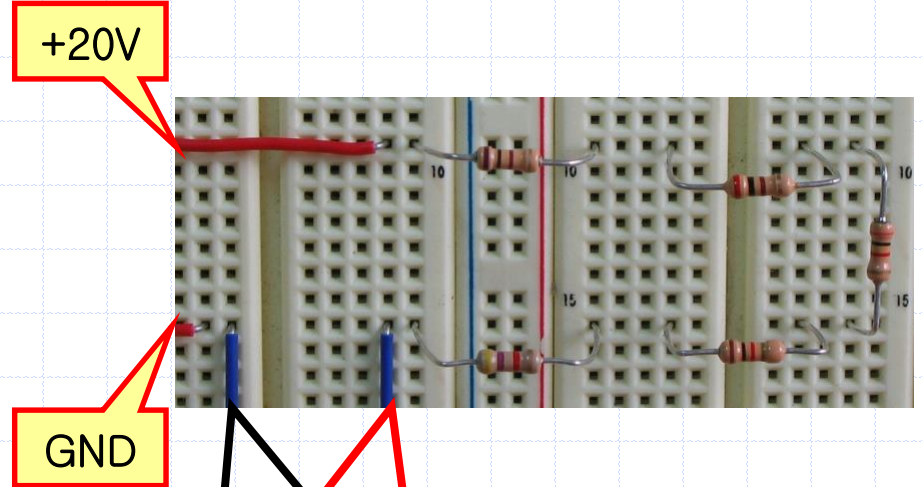
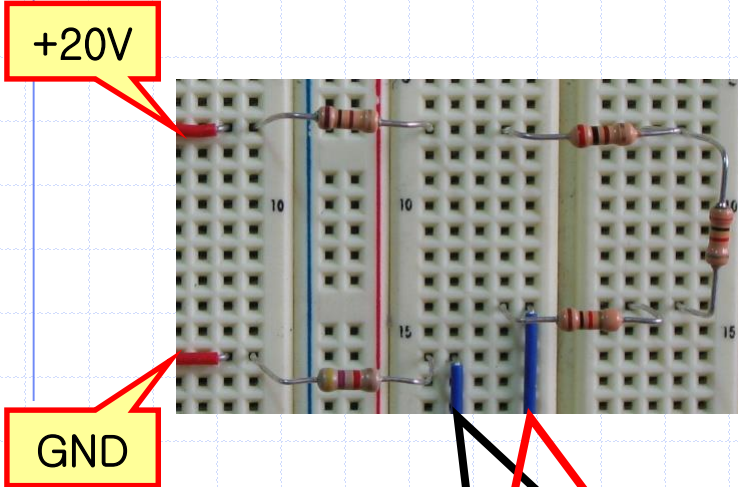


4

3



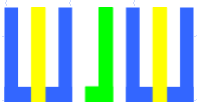
2-11B. 전류, 전압 측정 및 전력 계산



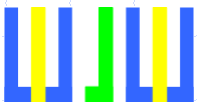
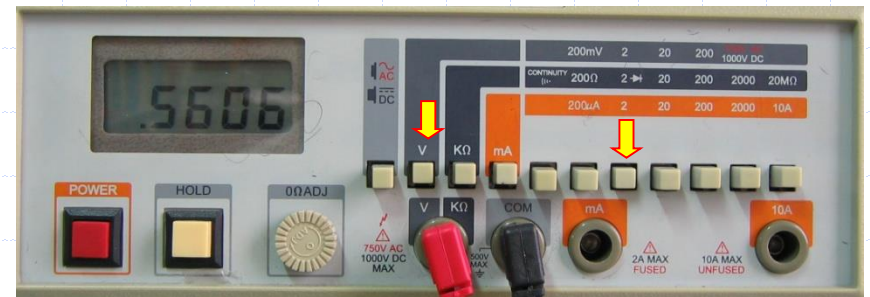
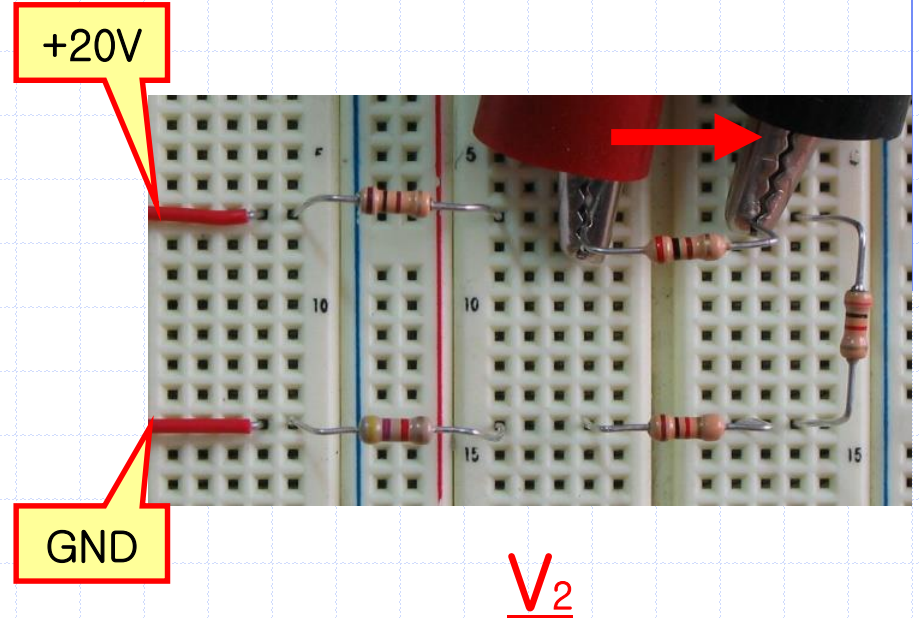
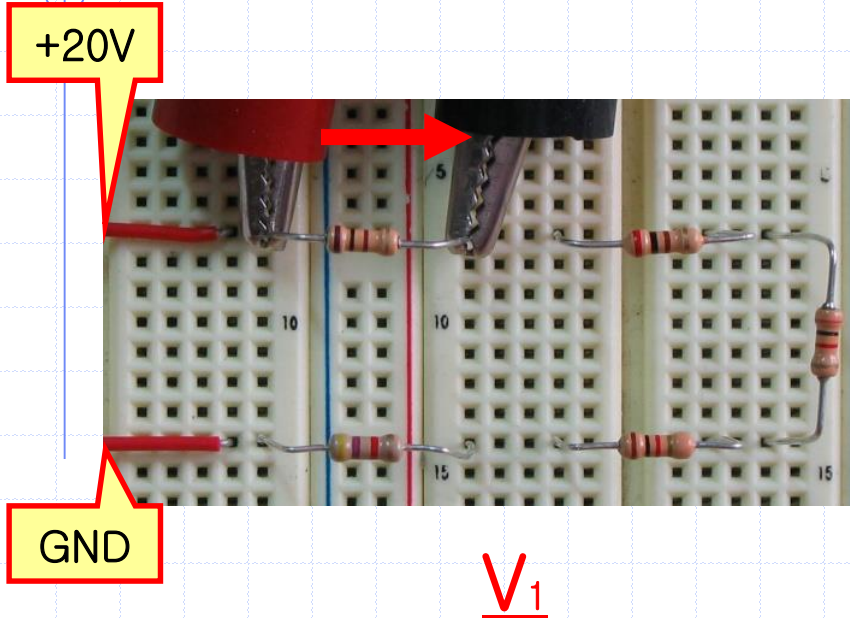
5



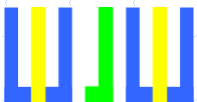
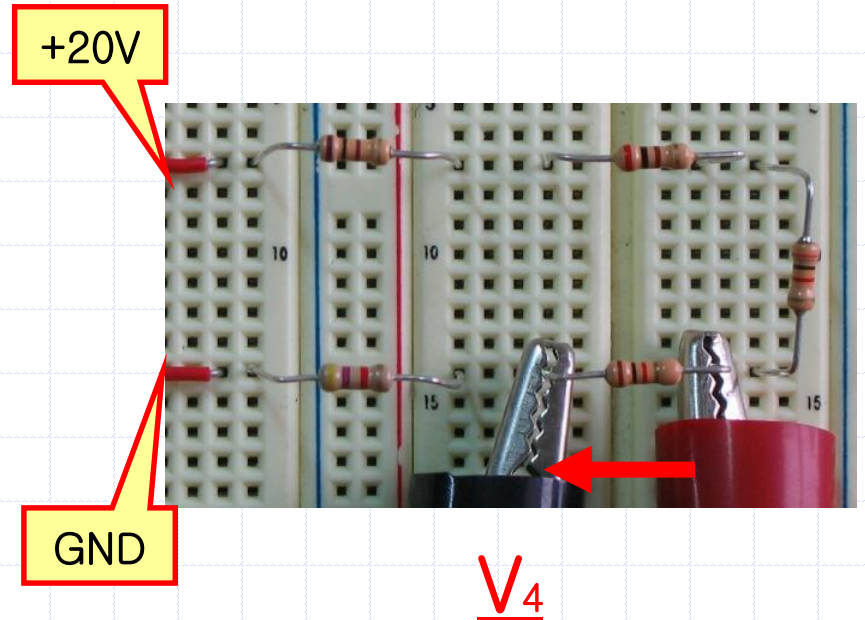
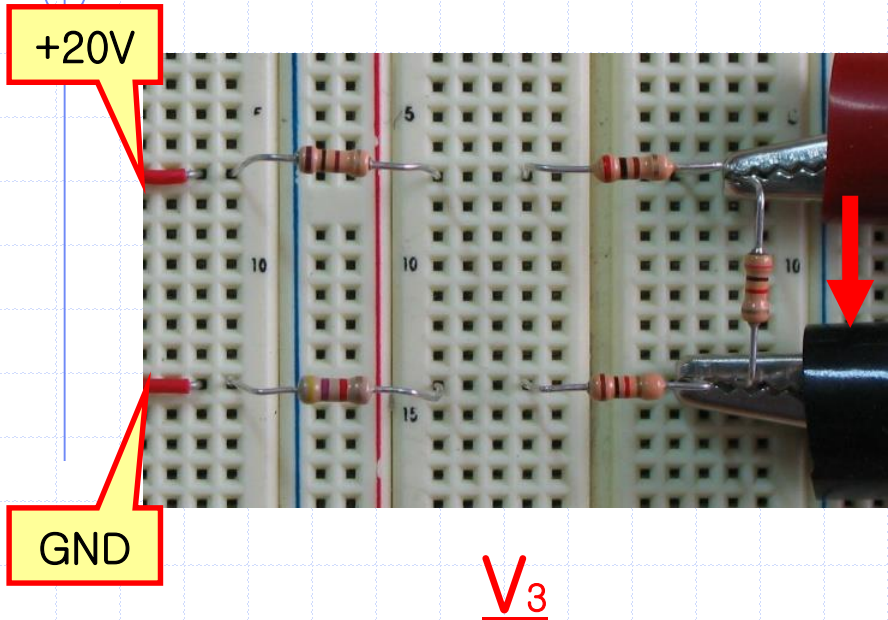
6



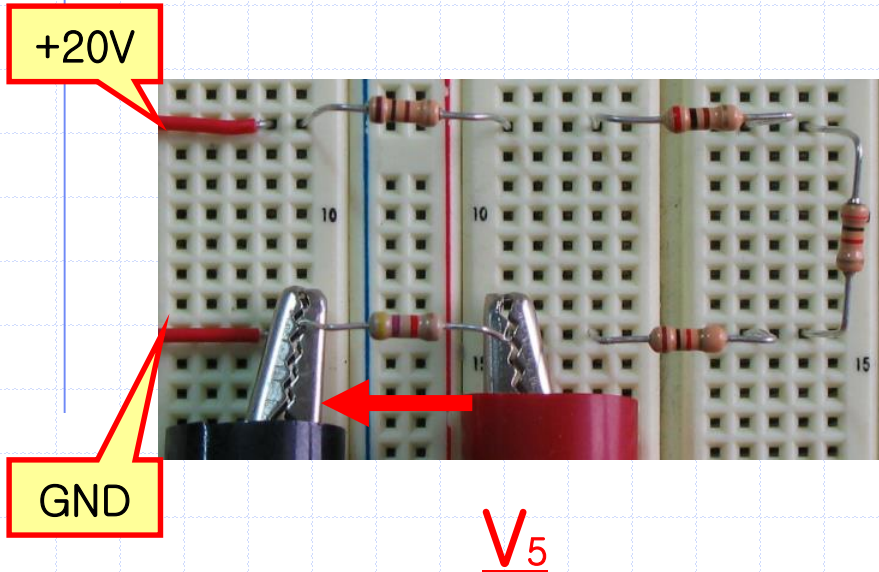
2-11B. 전류, 전압 측정 및 전력 계산



2-11B. 전류, 전압 측정 및 전력 계산



2-11B. 전류, 전압 측정 및 전력 계산



+20V

GND

V_5



전력 계산

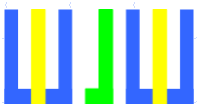
I_1	2.78 mA	V_1	0.28 V
P_1	$= I_1 \times V_1 = 0.7784 \text{ mW}$		

I_2	2.78 mA	V_2	0.56 V
P_1	$= I_2 \times V_2 = 1.5568 \text{ mW}$		

I_3	2.78 mA	V_3	8.33 V
P_3	$= I_3 \times V_3 = 24.84 \text{ mW}$		

I_4	2.78 mA	V_4	2.78 V
P_4	$= I_4 \times V_4 = 23.1574 \text{ mW}$		

I_5	2.78 mA	V_5	13.06 V
P_5	$= I_5 \times V_5 = 36.3068 \text{ mW}$		



2-12. 직류 전원 공급 장치 (DC Power Supply)

✓ DC Power Supply 사용하기

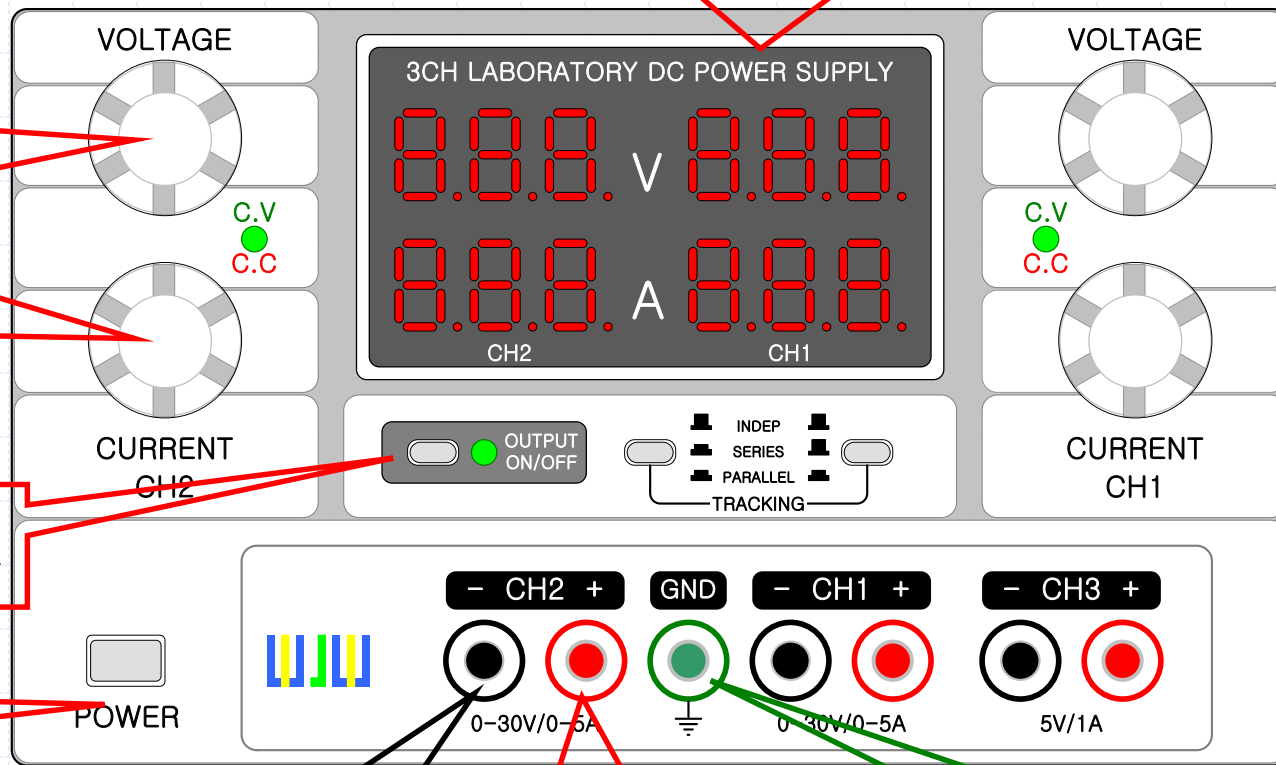
전압 및 전류 표시부

전압
조절
단자

전류
조절
단자

DC 출력
ON/OFF

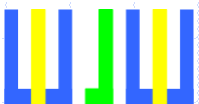
전원



- 단자 (검정)

+ 단자 (빨강)

GND 단자 (녹색)



2-12. 직류 전원 공급 장치 (DC Power Supply)

✓ DC Power Supply 사용하기

DC 출력
ON/OFF

전류 제한
확인 단자

전류 조절 단자

전압 및 전류 표시부

전압
조절
단자

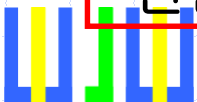
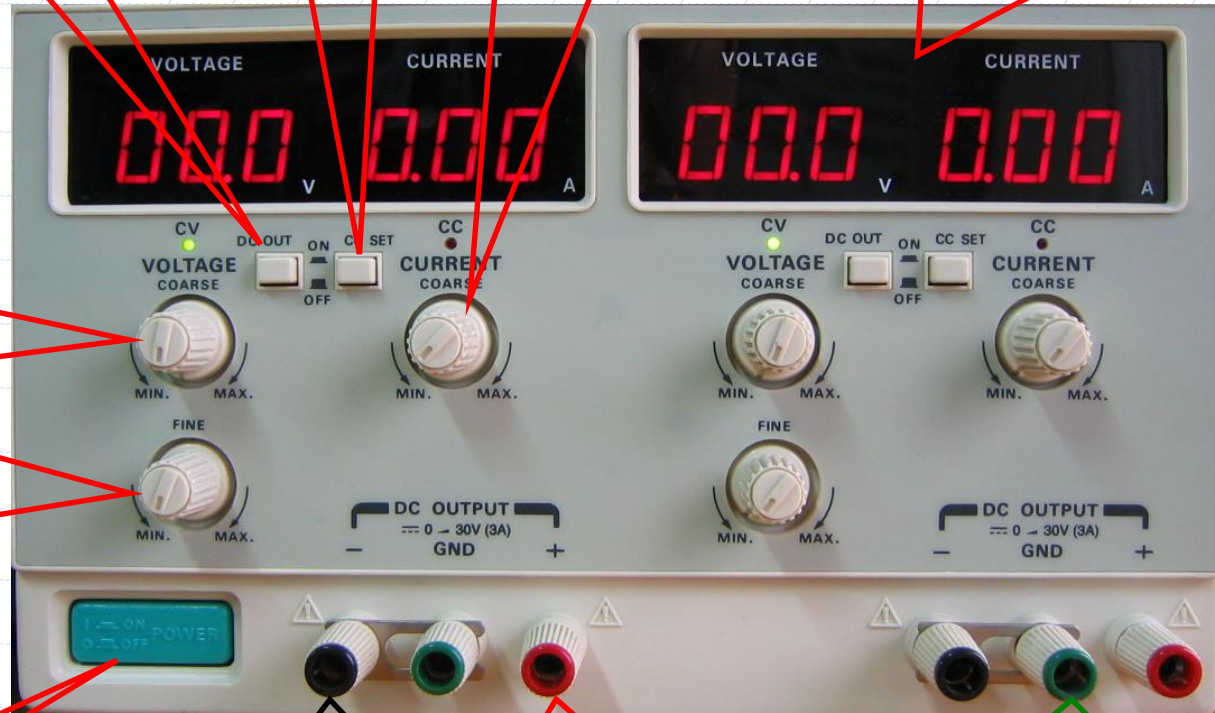
전압
미세
조절
단자

전원

- 단자 (검정)

+ 단자 (빨강)

GND 단자 (녹색)



2-12. 직류 전원 공급 장치 (DC Power Supply)

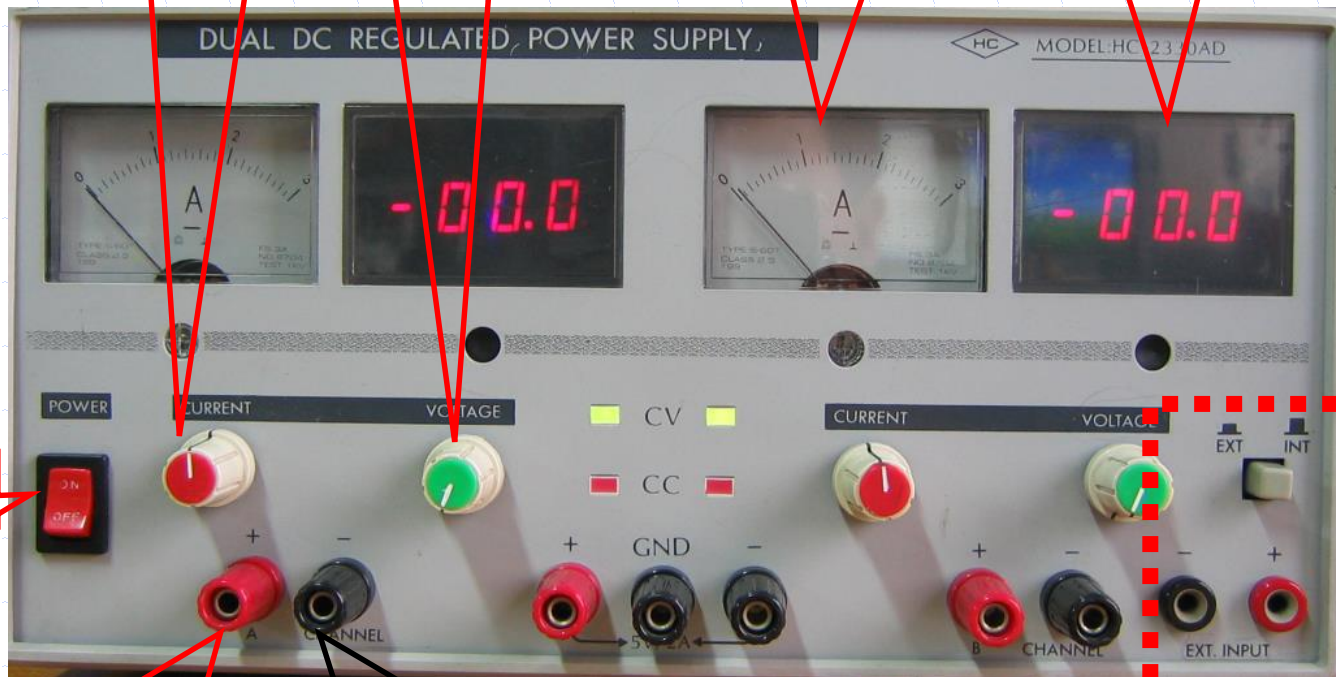
- ✓ DC Power Supply 사용하기

전류 조절 단자

전압 조절 단자

전류 표시부

전압 표시부



전원

+단자 (빨강)

-단자 (검정)

외부 전압 측정

