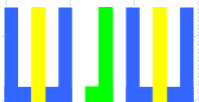


회로 이론/실습

4. 직렬과 병렬로 조합된 저항 회로의 전류, 전압 및 전력



4. 직렬과 병렬로 조합된 저항 회로의 전류, 전압 및 전력

4-1. 목적 및 배경

4-2. 소요 부품 및 장비

4-3. 유용한 공식

4-4. 디지털 멀티미터 (저항 측정)

4-5. 저항 측정

4-6. 디지털 멀티미터 (전류 측정)

4-7. 전류 측정

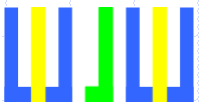
4-8. 디지털 멀티미터 (전압 측정)

4-9. 전압 측정

4-10. 전력 계산

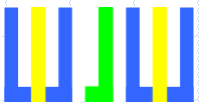
4-11. 직류 전원 공급기

4-12. 전류 측정 범위의 선택



4-1. 목적 및 배경

- ✓ 저항이 직렬과 병렬로 조합된 회로의 총저항의 값을 계산한다.
- ✓ 디지털 멀티미터 (Digital Multi-Meter : DMM) 를 이용하여 직·병렬로 연결된 회로의 저항값을 측정한다.
- ✓ 디지털 멀티미터 (Digital Multi-Meter : DMM) 를 이용하여 직·병렬로 연결된 회로의 전압과 전류를 측정한다.
- ✓ 측정된 전압과 전류를 이용하여 전력을 계산한다.



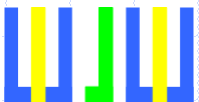
4-2. 소요 부품 및 장비

✓ 부품

- ✓ 저항 (1/4W) : 10Ω, 100Ω, 200Ω, 1kΩ, 2kΩ, 1MΩ

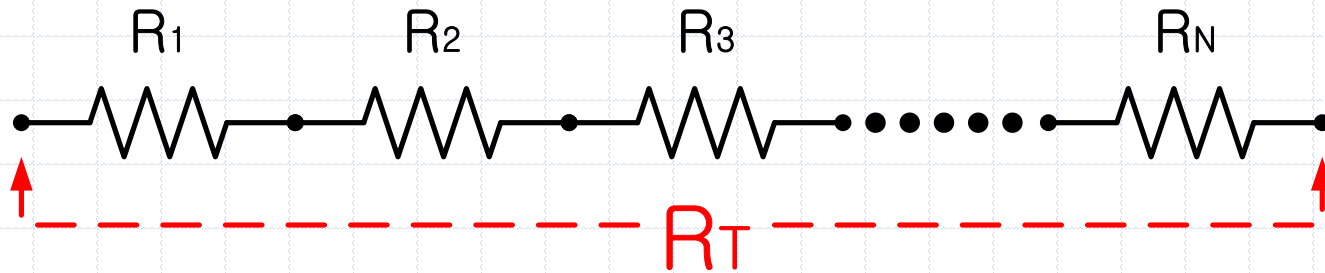
✓ 장비

- ✓ 브레드 보드
- ✓ 디지털 멀티미터 (Digital Multi-Meter)
- ✓ 직류전원공급장치 (DC Power Supply)

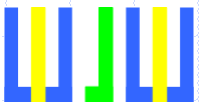


4-3. 유용한 공식

✓ 저항의 직렬 연결



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



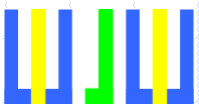
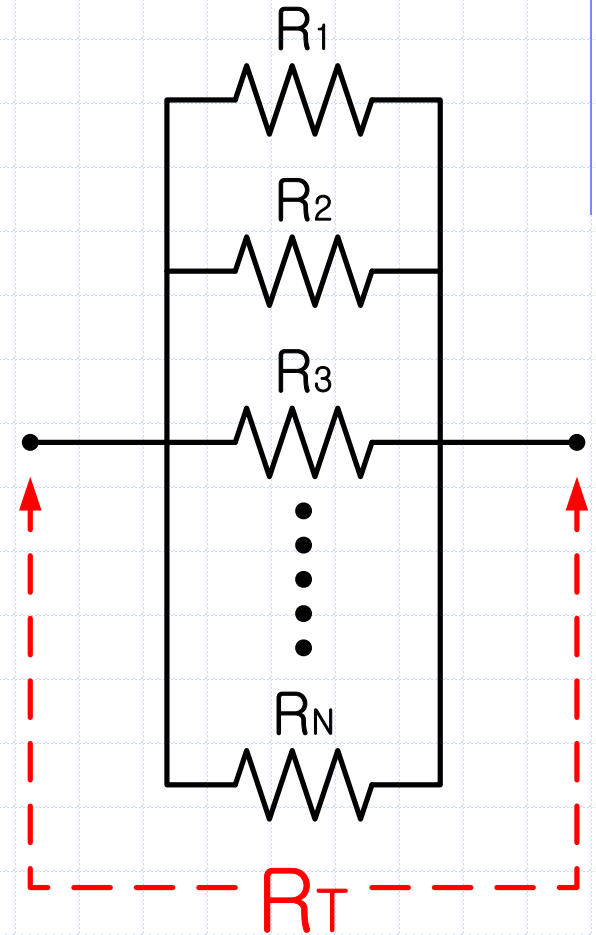
4-3. 유용한 공식

✓ 저항의 병렬 연결

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots + \frac{1}{R_N}$$

✓ 저항이 2개인 경우

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$



4-3. 유용한 공식

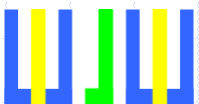
- ✓ 옴의 법칙 (Ohm's Law)

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

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

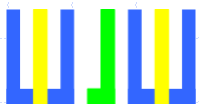
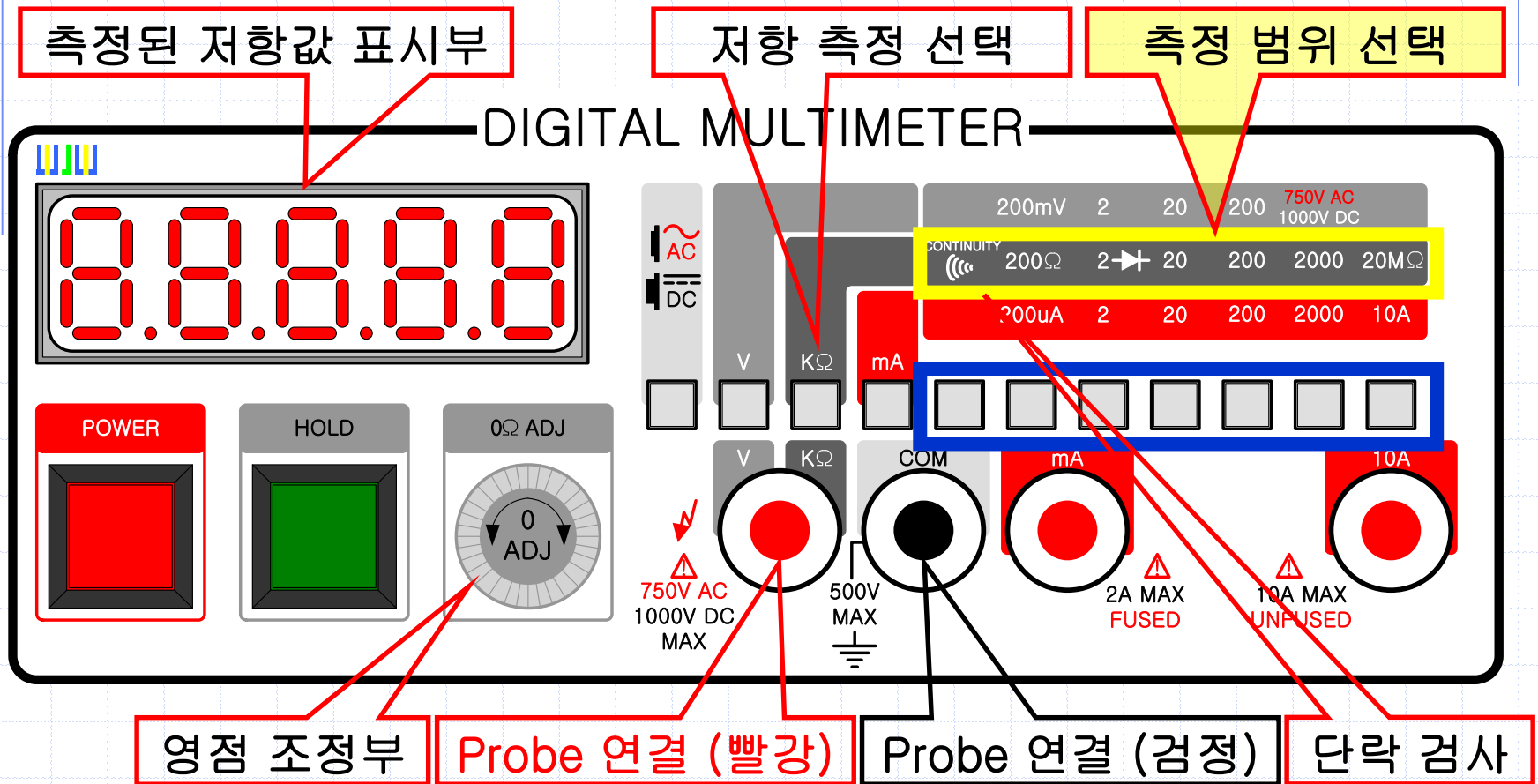
- ✓ 전력 (Power), P, W, Watt

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

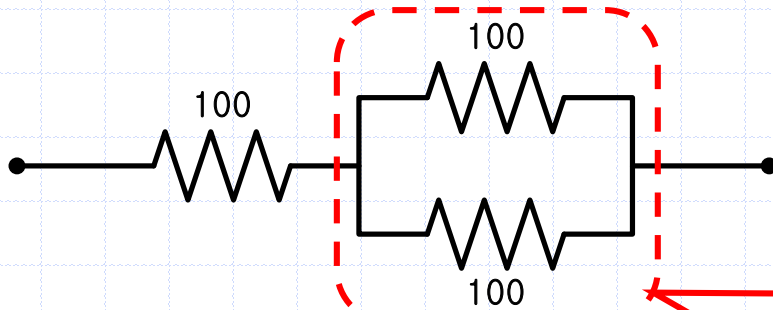


4-4. 디지털 멀티미터 (DMM)-저항 측정

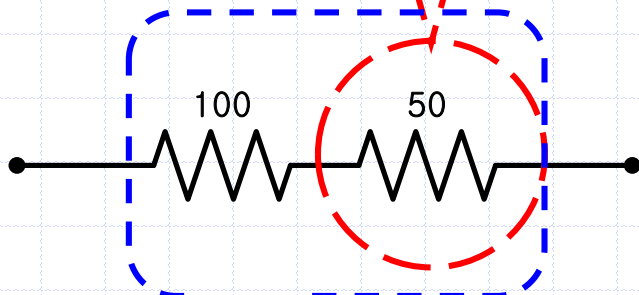
✓ Digita Multi Meter 사용하기 (저항 측정)



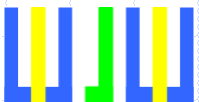
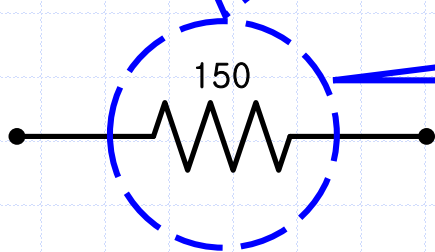
4-5A. 저항 측정



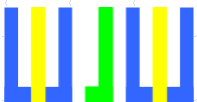
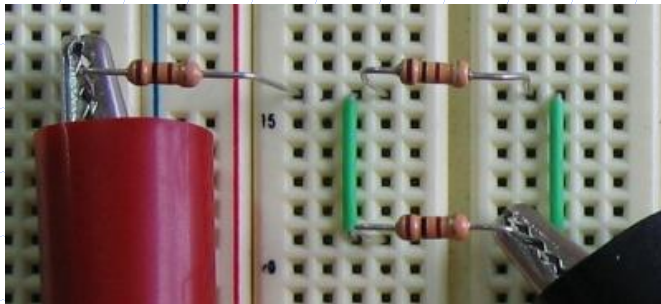
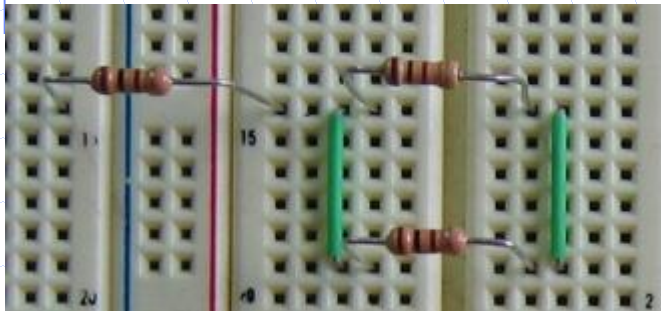
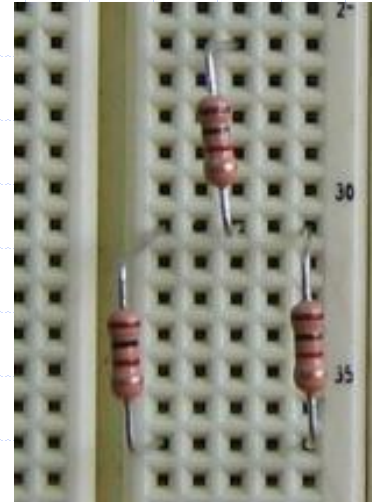
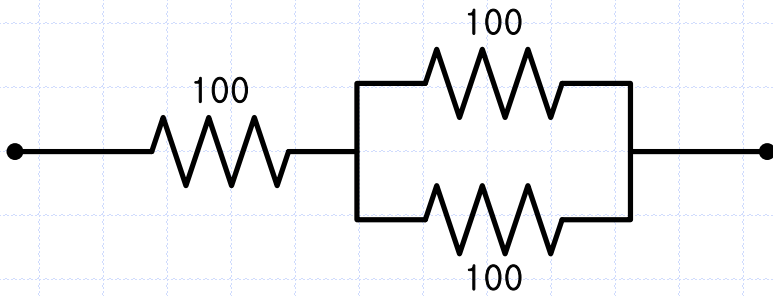
$$\begin{aligned} R_T &= \frac{R_1 \times R_2}{R_1 + R_2} \\ &= \frac{100\Omega \times 100\Omega}{100\Omega + 100\Omega} \\ &= \frac{10,000\Omega}{200\Omega} \\ &= 50\Omega \end{aligned}$$



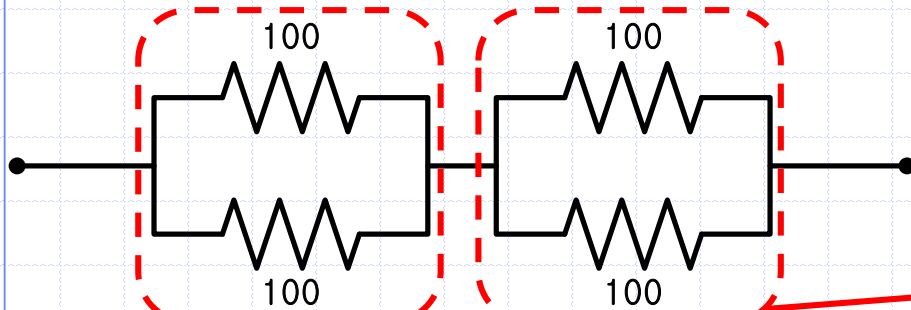
$$\begin{aligned} R_T &= R_1 + R_2 \\ &= 100\Omega + 50\Omega \\ &= 150\Omega \end{aligned}$$



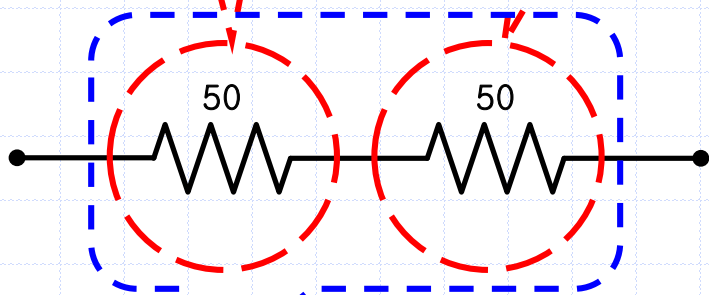
4-5A. 저항 측정



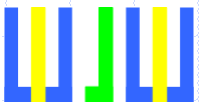
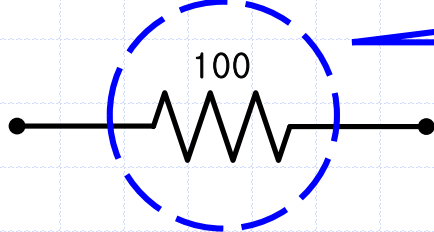
4-5B. 저항 측정



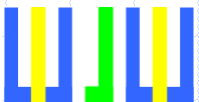
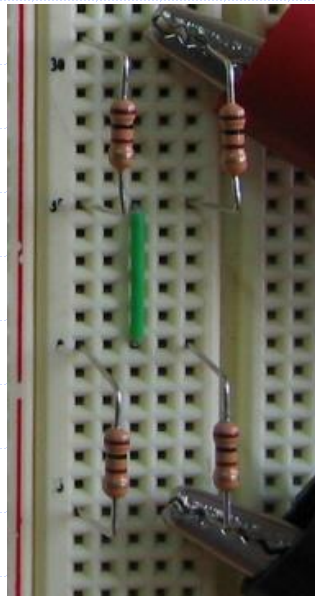
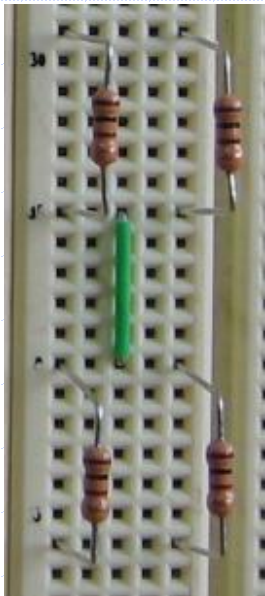
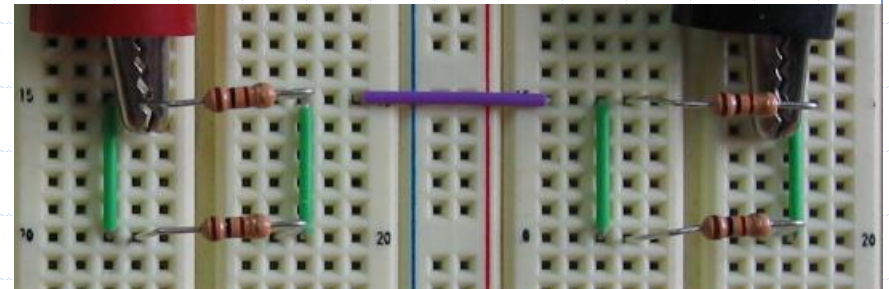
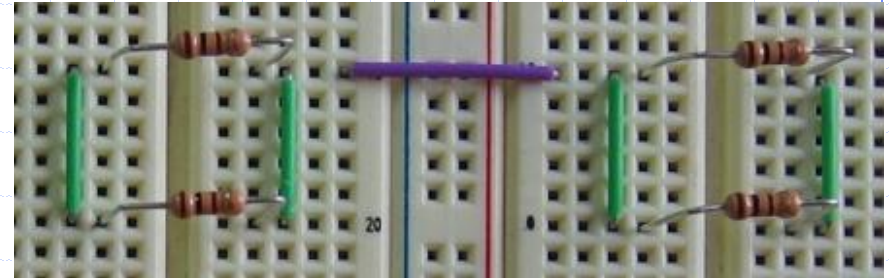
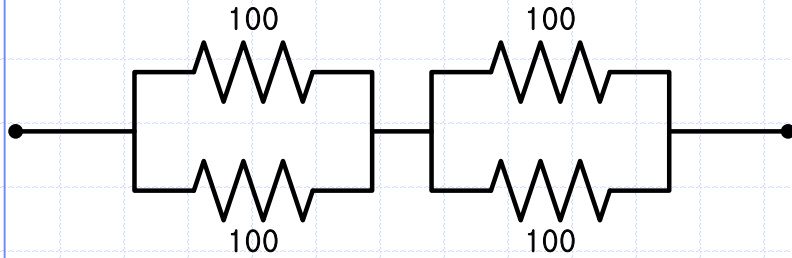
$$\begin{aligned} R_T &= \frac{R_1 \times R_2}{R_1 + R_2} \\ &= \frac{100\Omega \times 100\Omega}{100\Omega + 100\Omega} \\ &= \frac{10,000\Omega}{200\Omega} \\ &= 50\Omega \end{aligned}$$



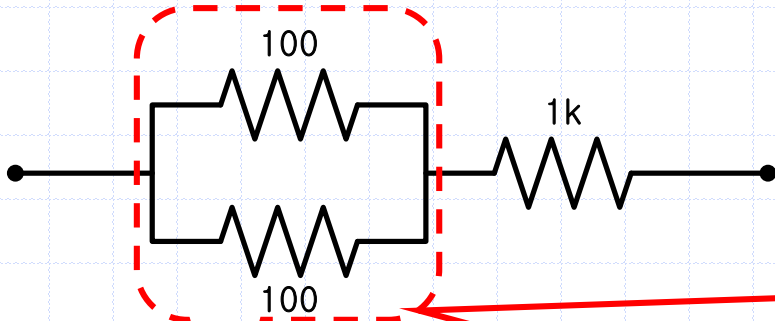
$$\begin{aligned} R_T &= R_1 + R_2 \\ &= 50\Omega + 50\Omega \\ &= 100\Omega \end{aligned}$$



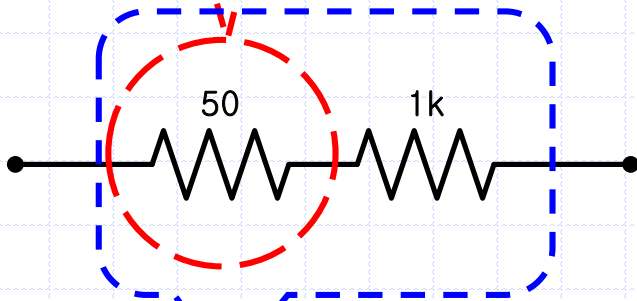
4-5B. 저항 측정



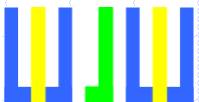
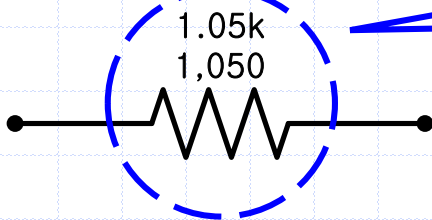
4-5C. 저항 측정



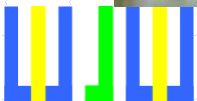
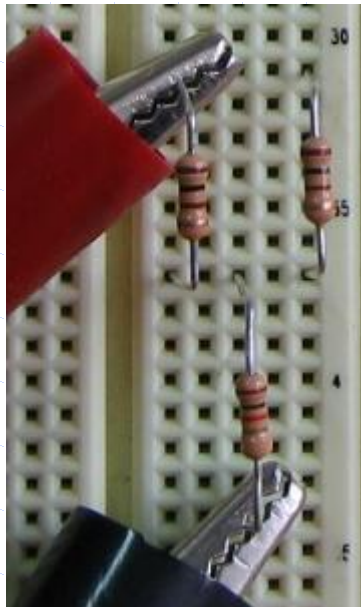
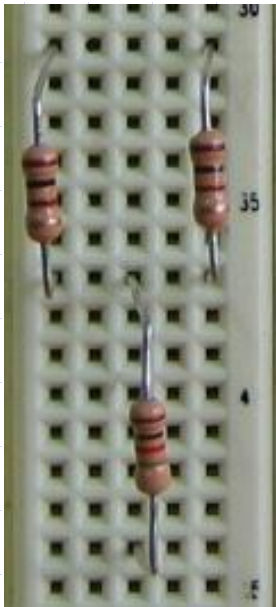
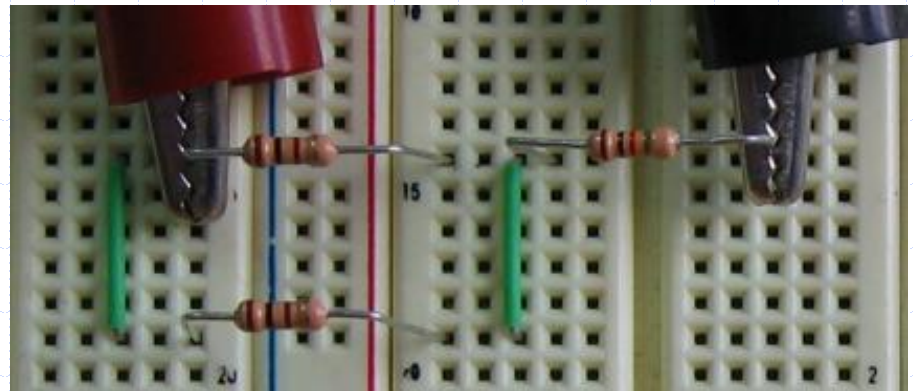
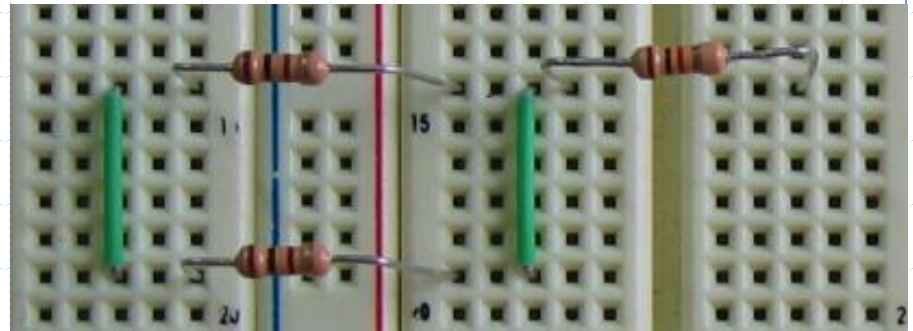
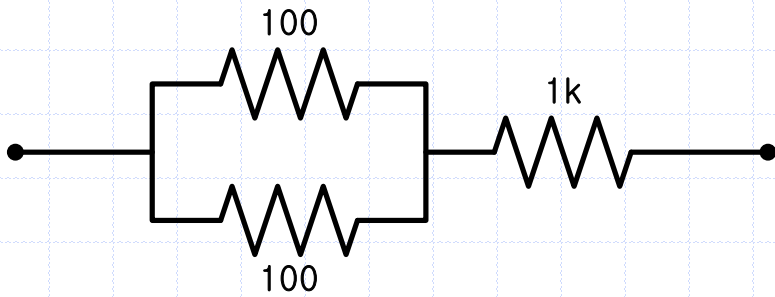
$$\begin{aligned} R_T &= \frac{R_1 \times R_2}{R_1 + R_2} \\ &= \frac{100\Omega \times 100\Omega}{100\Omega + 100\Omega} \\ &= \frac{10,000\Omega}{200\Omega} \\ &= 50\Omega \end{aligned}$$



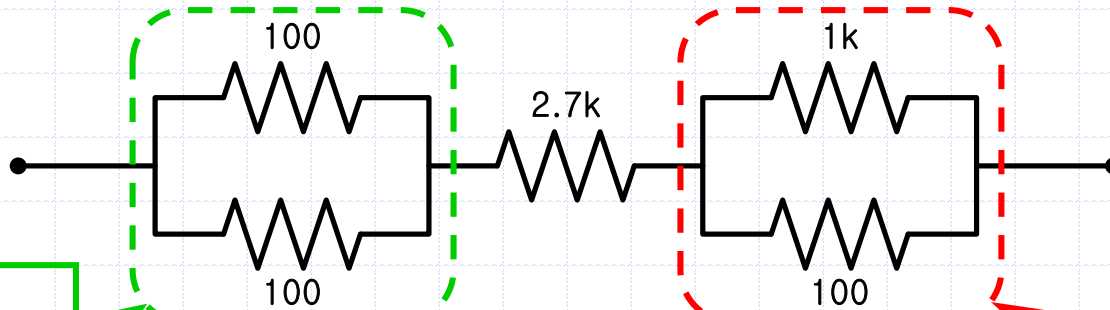
$$\begin{aligned} R_T &= R_1 + R_2 \\ &= 1k\Omega + 50\Omega \\ &= 1,000\Omega + 50\Omega \\ &= 1,050\Omega \end{aligned}$$



4-5C. 저항 측정



4-5D. 저항 측정



$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

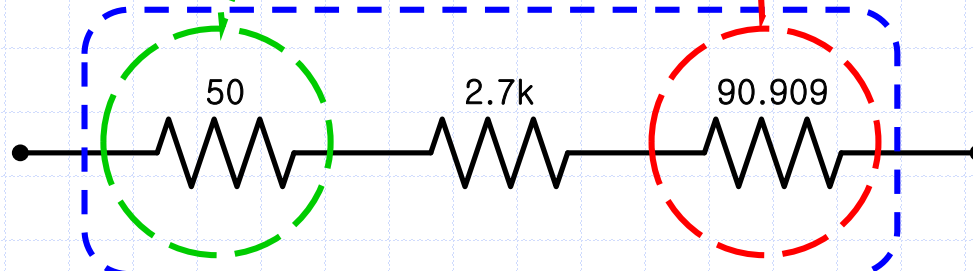
$$= \frac{100\Omega \times 100\Omega}{100\Omega + 100\Omega}$$

$$= 50\Omega$$

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

$$= \frac{1000\Omega \times 100\Omega}{1000\Omega + 100\Omega}$$

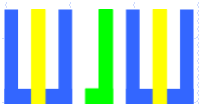
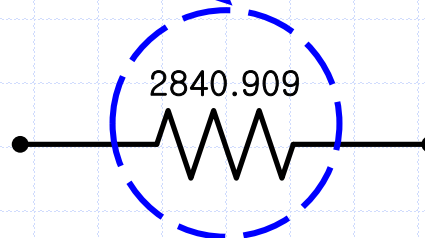
$$= 90.909\Omega$$



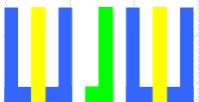
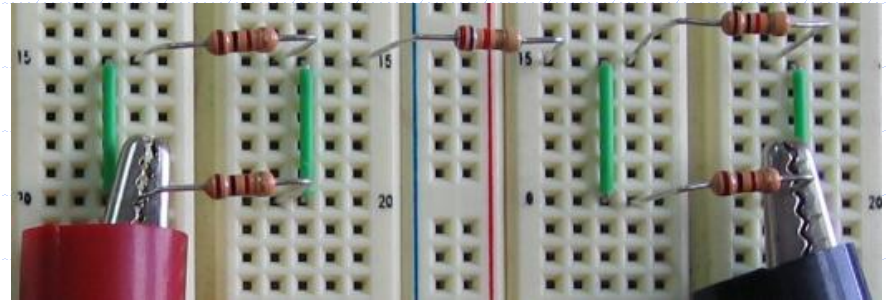
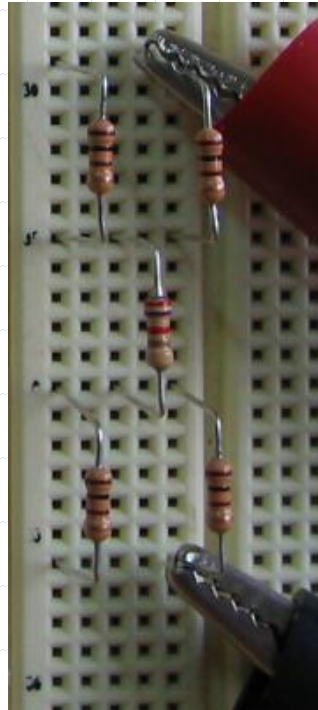
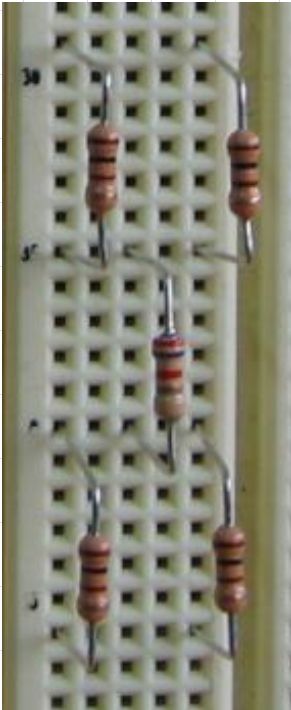
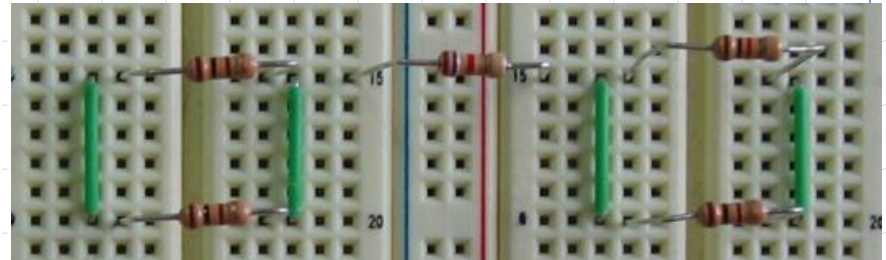
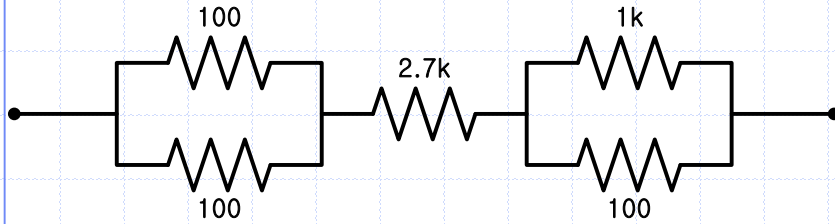
$$R_T = R_1 + R_2 + R_3$$

$$= 50\Omega + 2700\Omega + 90.909\Omega$$

$$= 2840.909\Omega$$

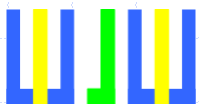
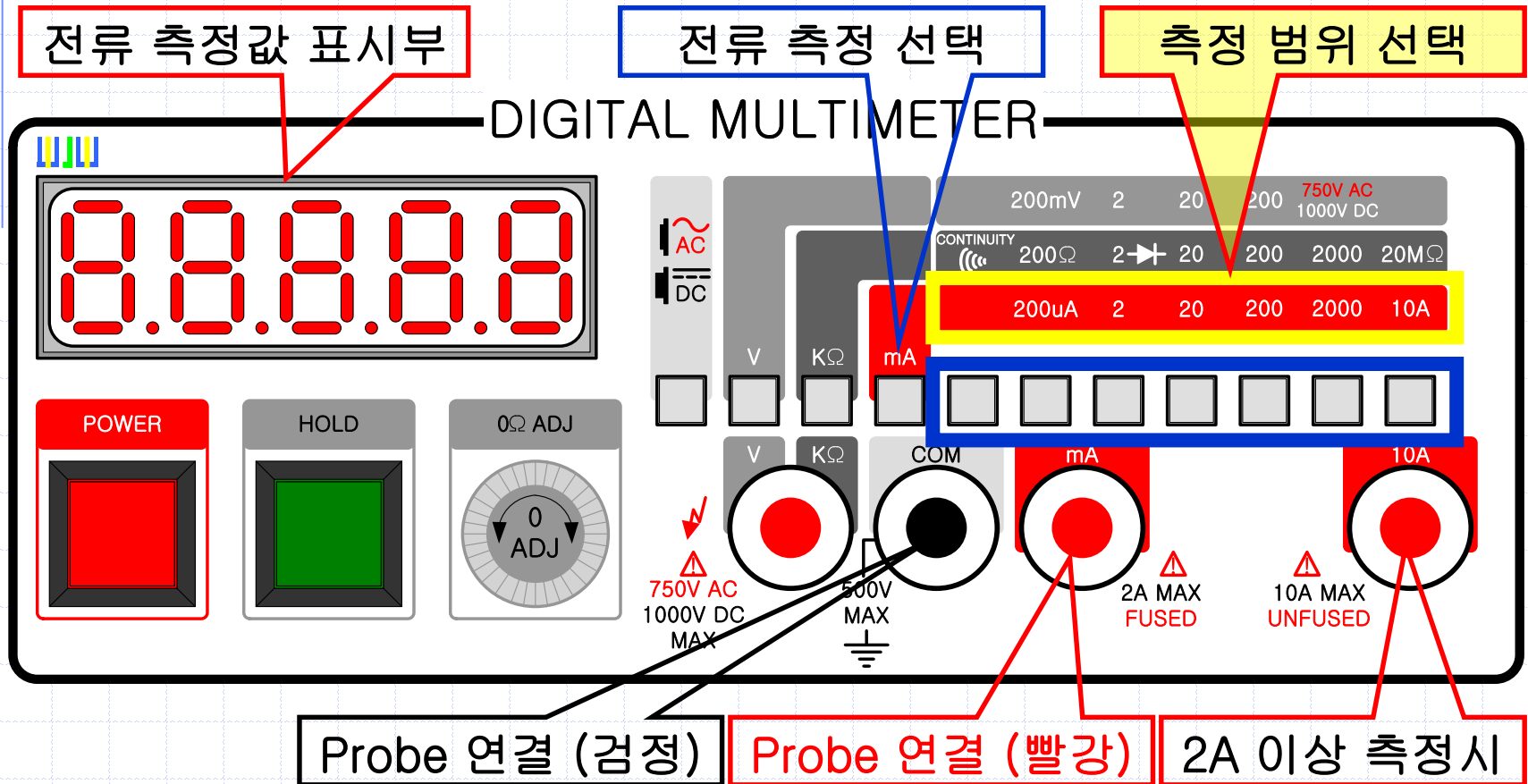


4-5D. 저항 측정



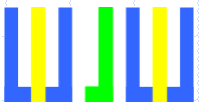
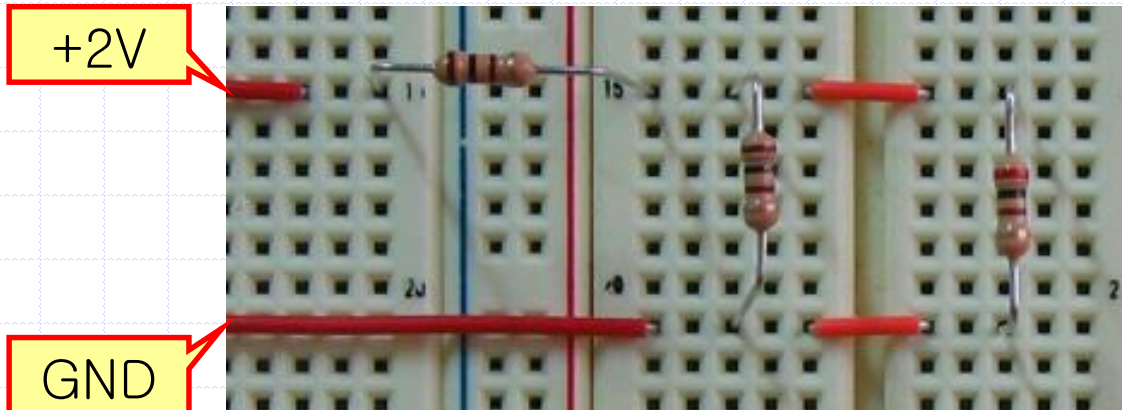
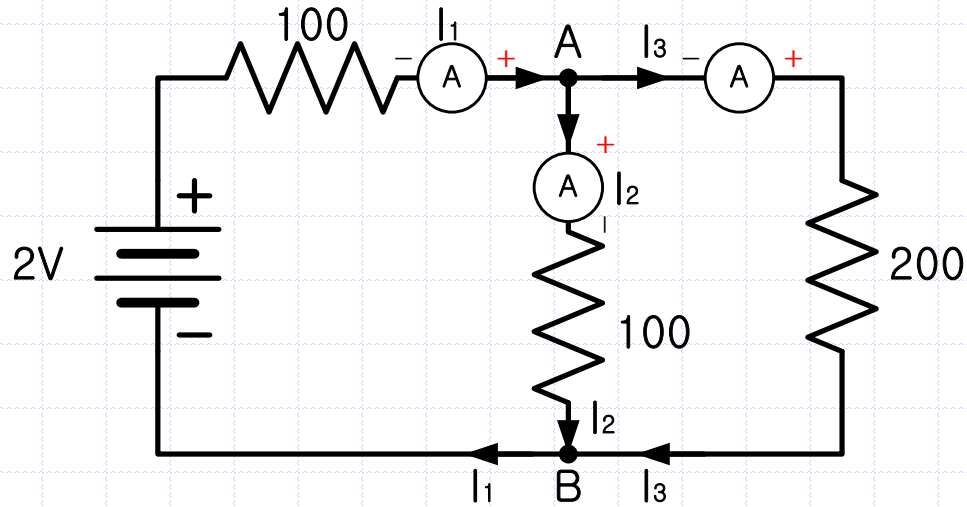
4-6. 디지털 멀티미터 (DMM)-전류 측정

✓ DMM 사용하기 (전류 측정)

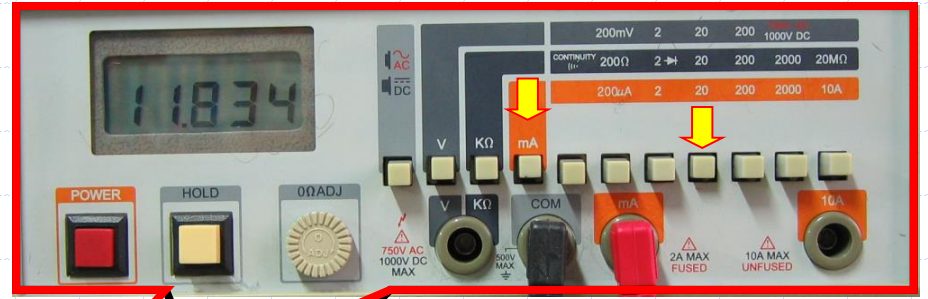
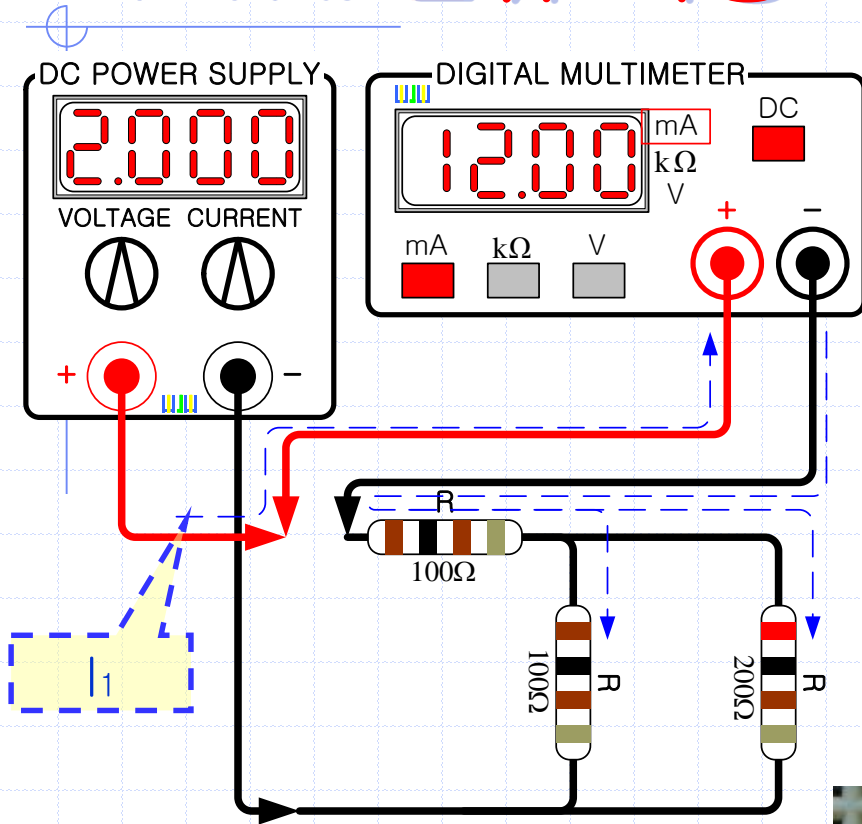


4-7A. 전류 측정

- ✓ 전류의 측정 방법 : 회로와 직렬로 연결하여 측정

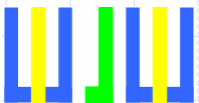
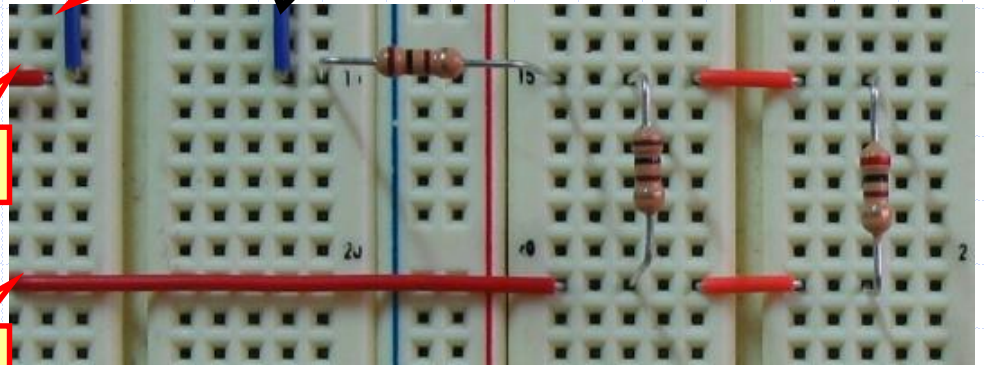


4-7A. 전류 측정

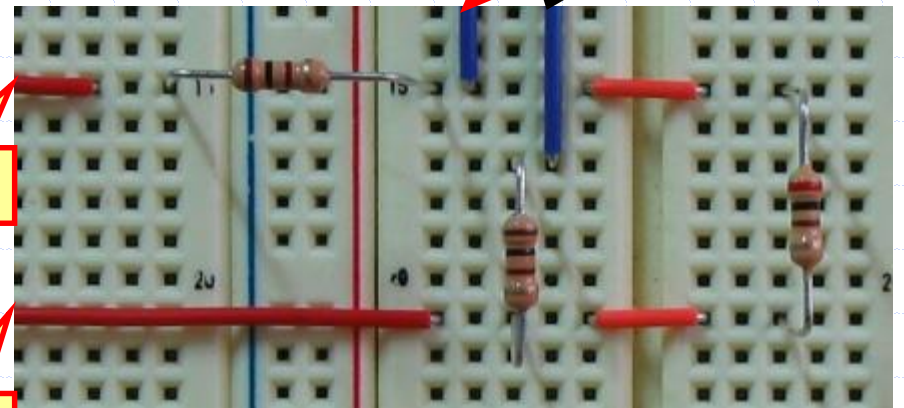
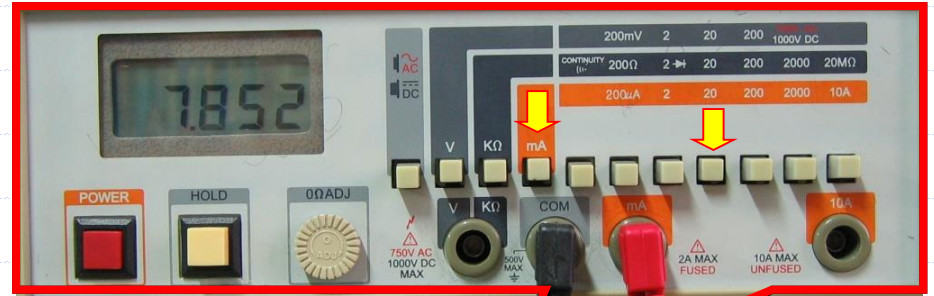
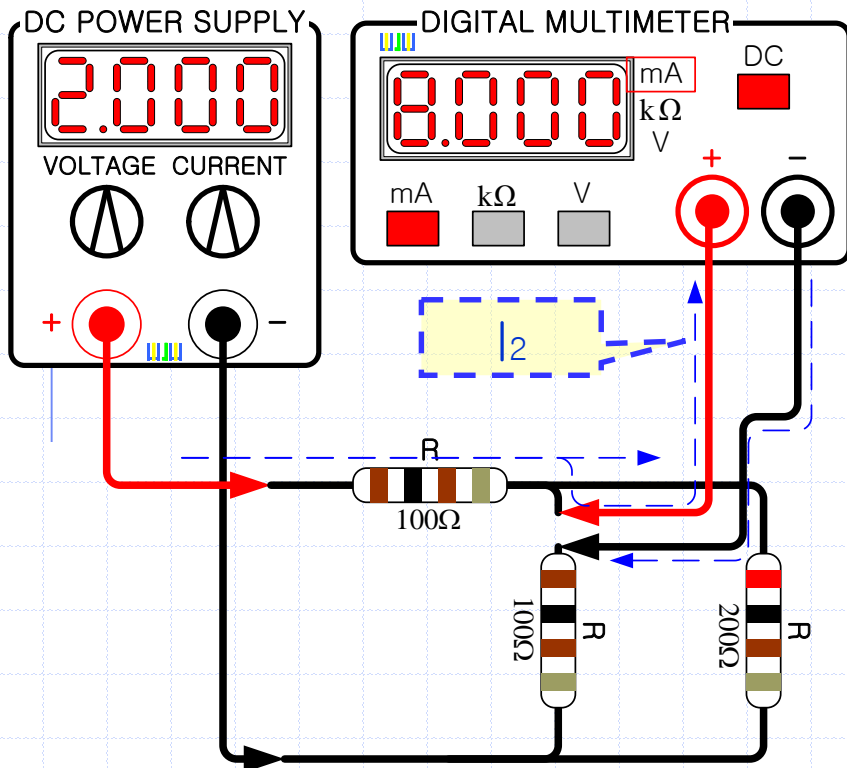


+2V

GND

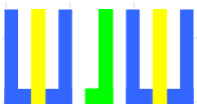


4-7A. 전류 측정

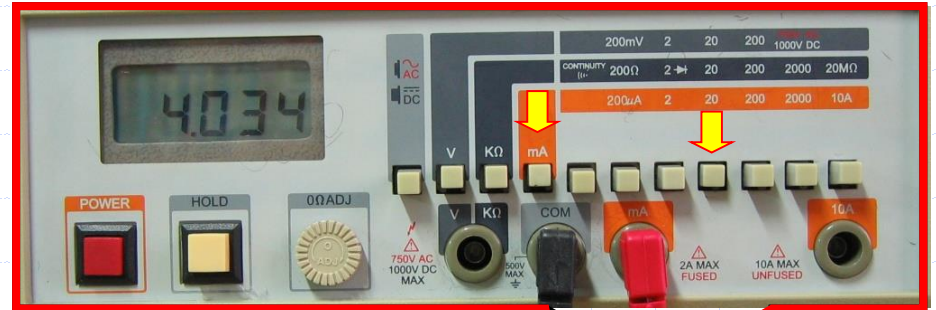
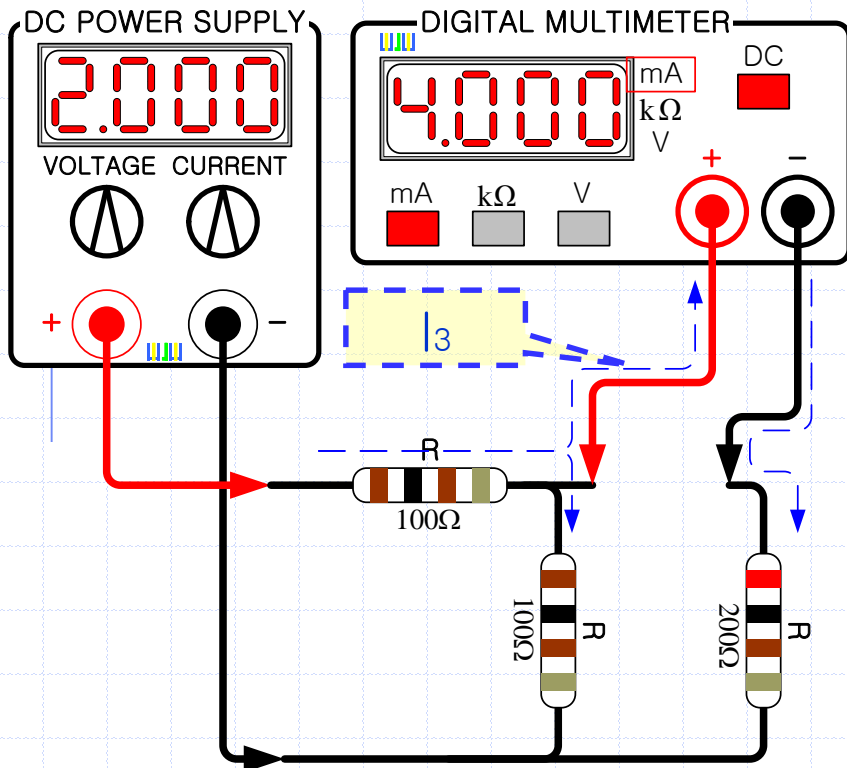


+2V

GND

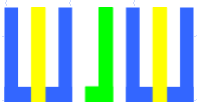
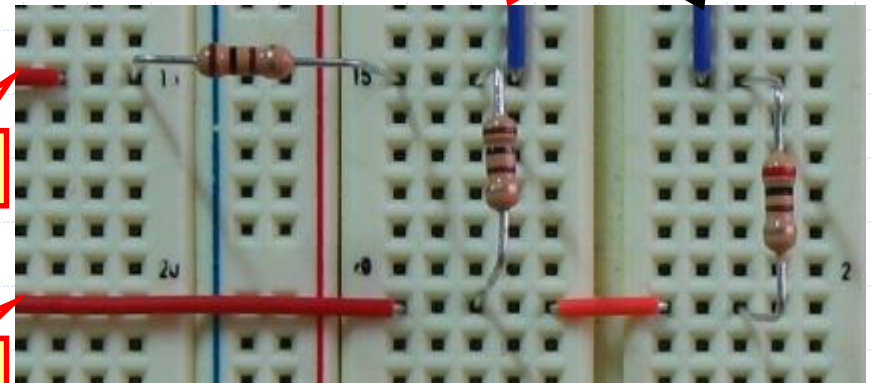


4-7A. 전류 측정

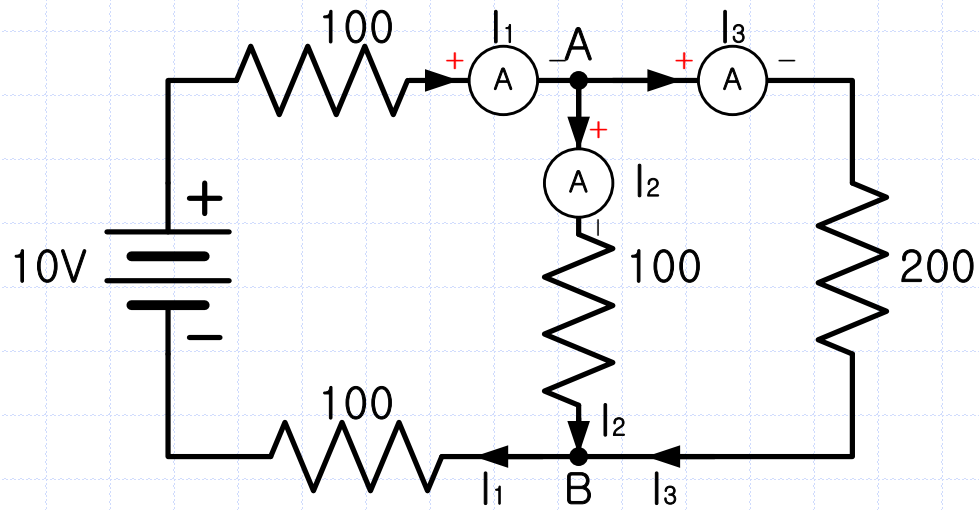


+2V

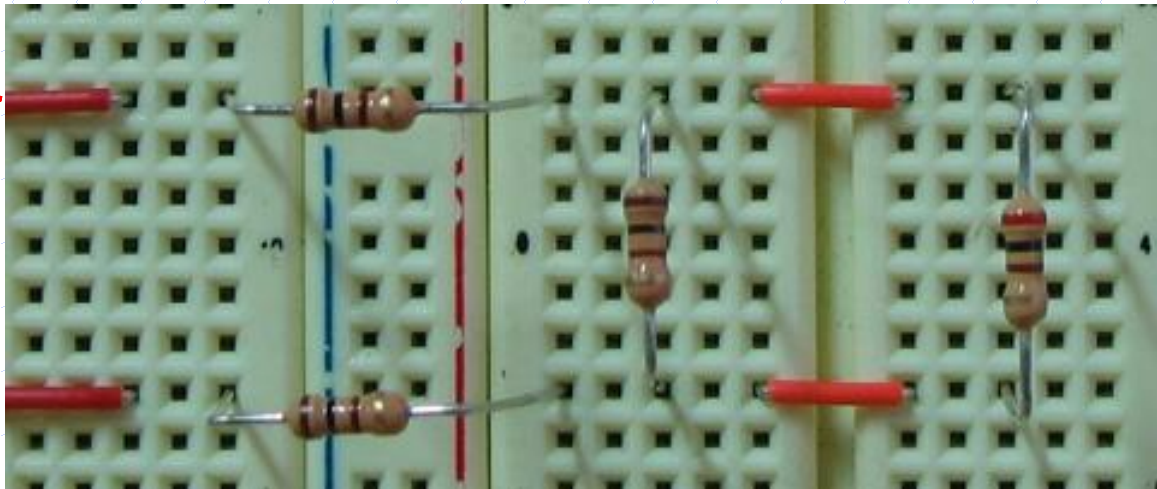
GND



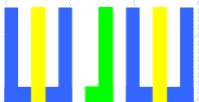
4-7B. 전류 측정



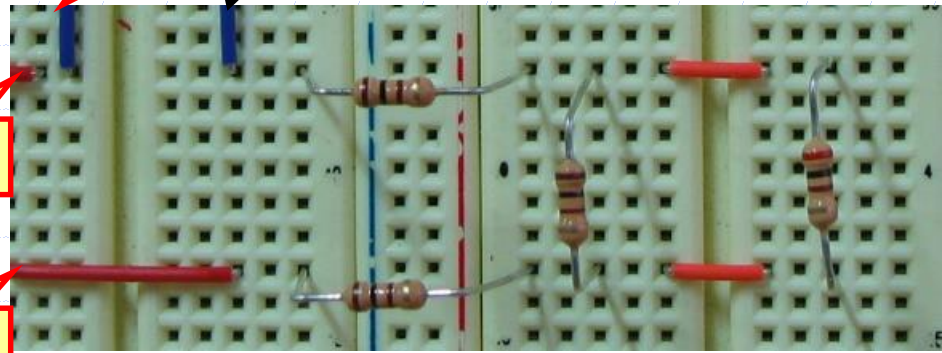
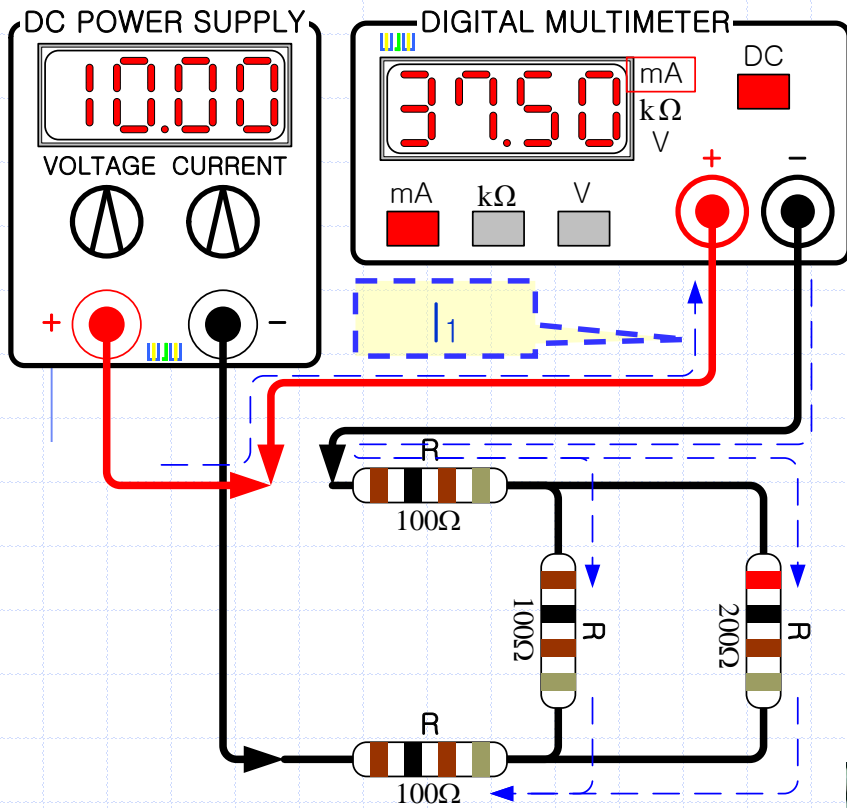
+2V



GND

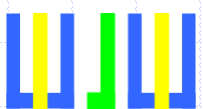


4-7B. 전류 측정

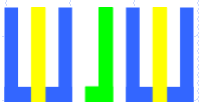
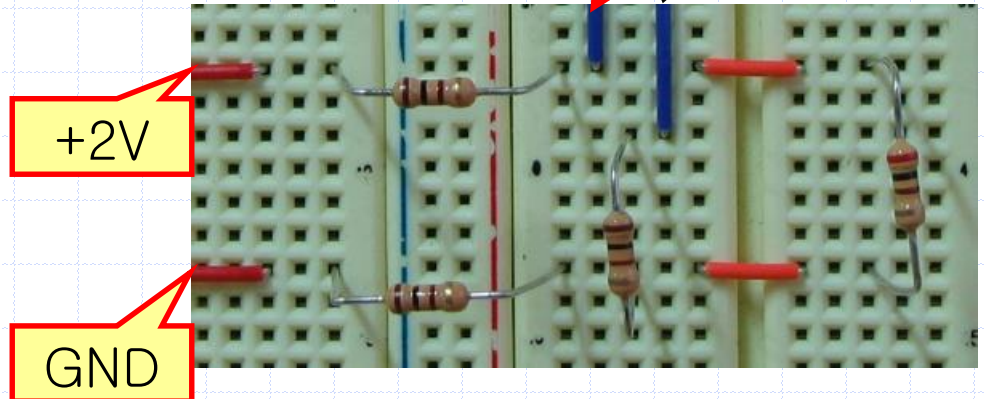
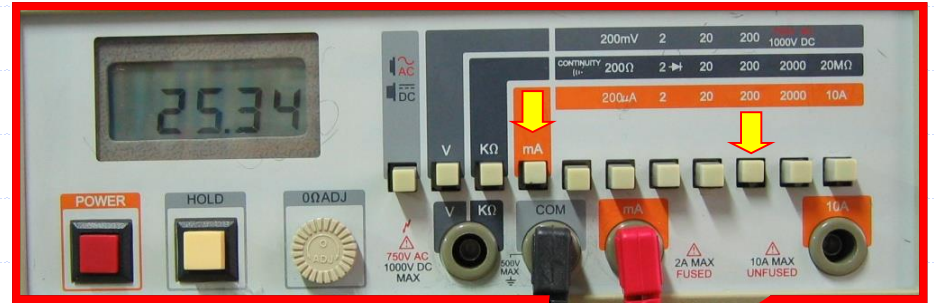
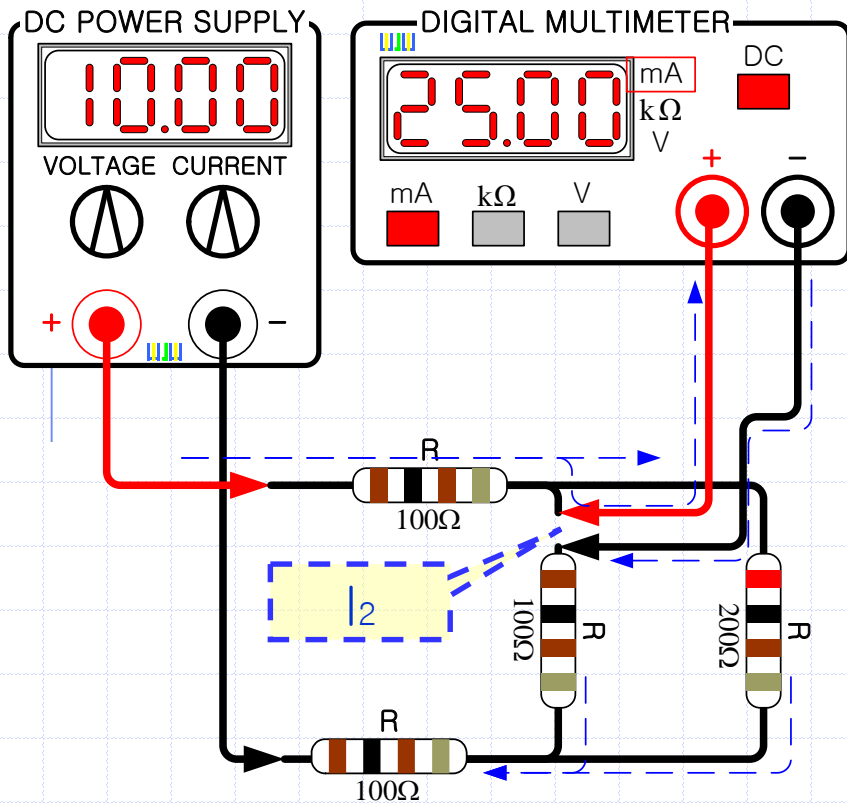


+2V

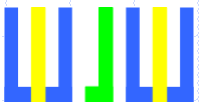
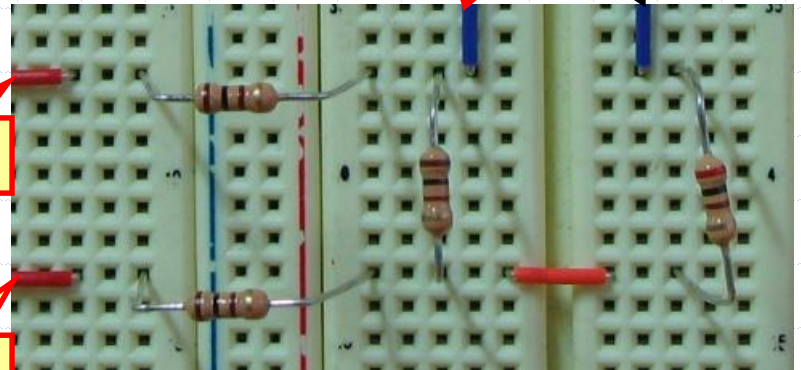
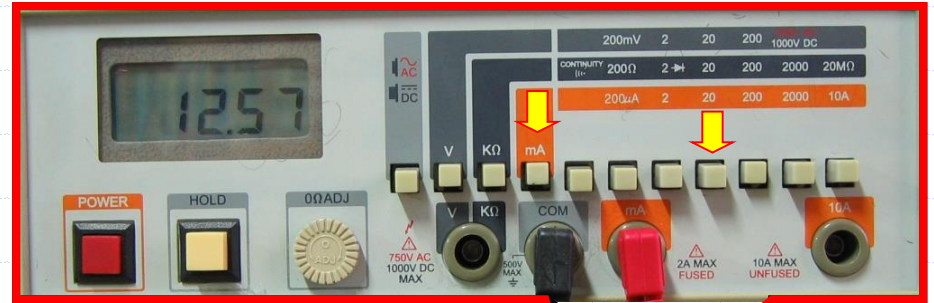
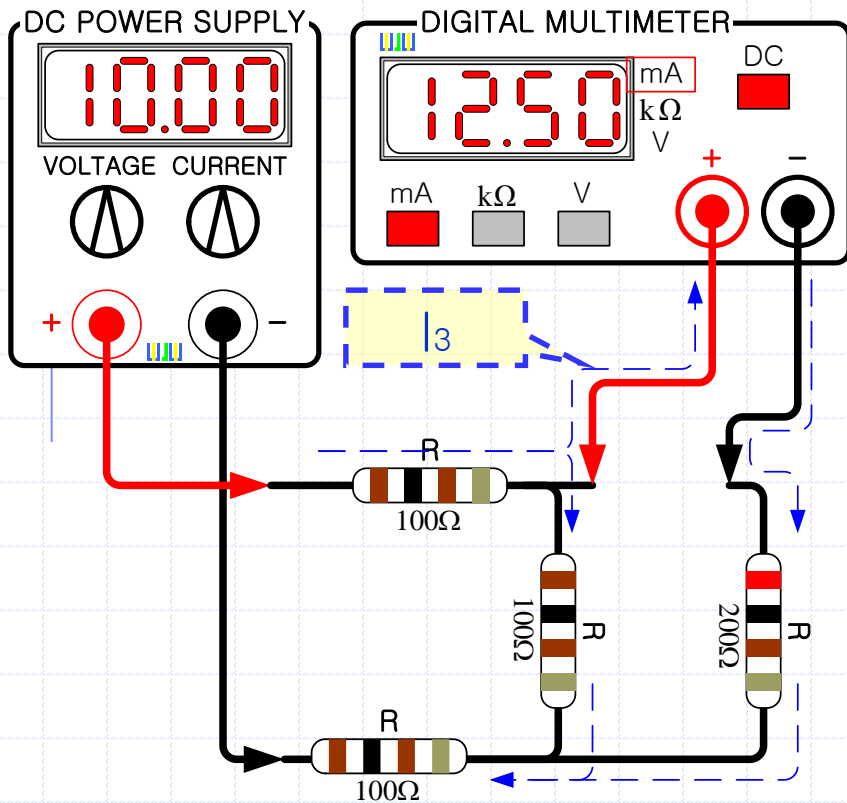
GND



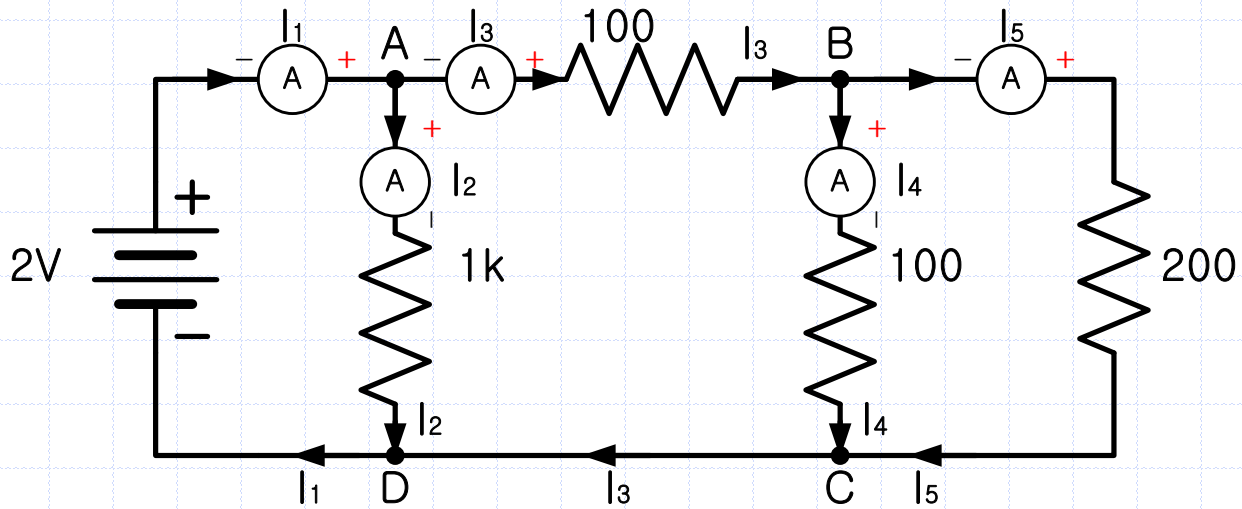
4-7B. 전류 측정



4-7B. 전류 측정

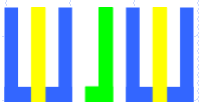
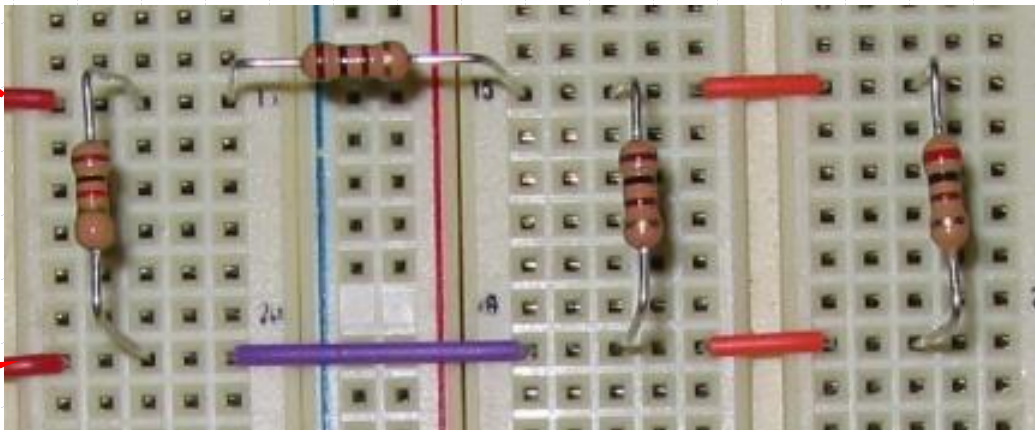


4-7C. 전류 측정

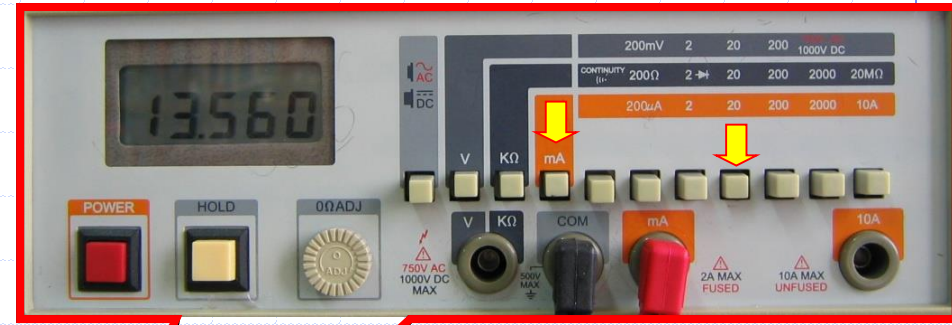
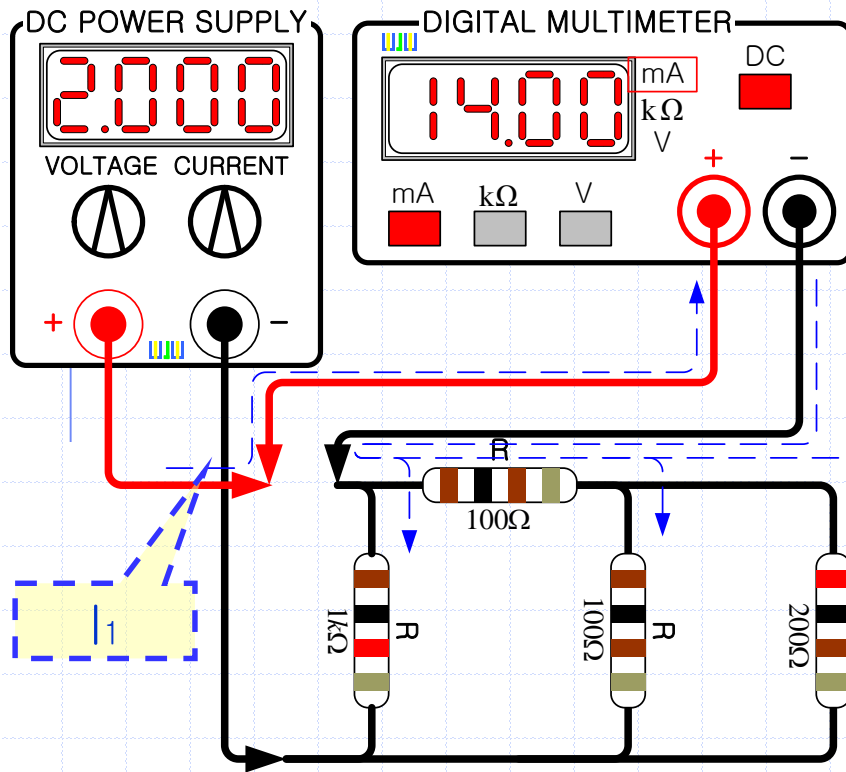


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GND

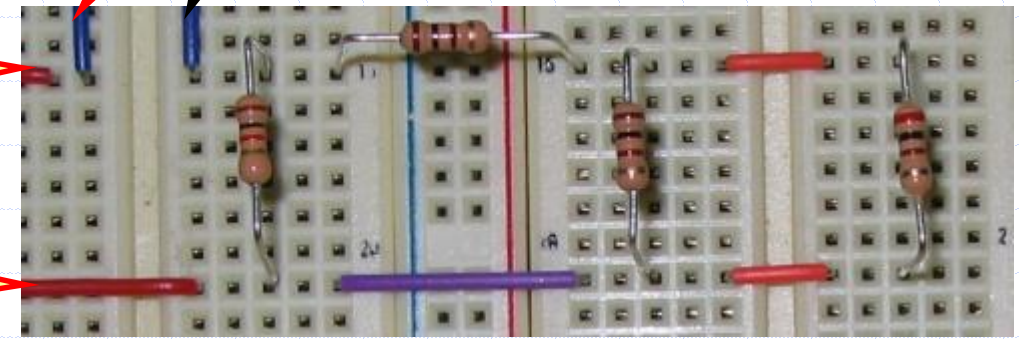


4-7C. 전류 측정

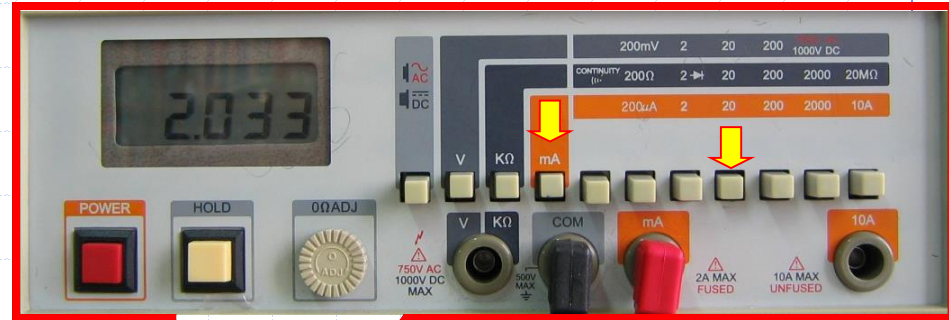
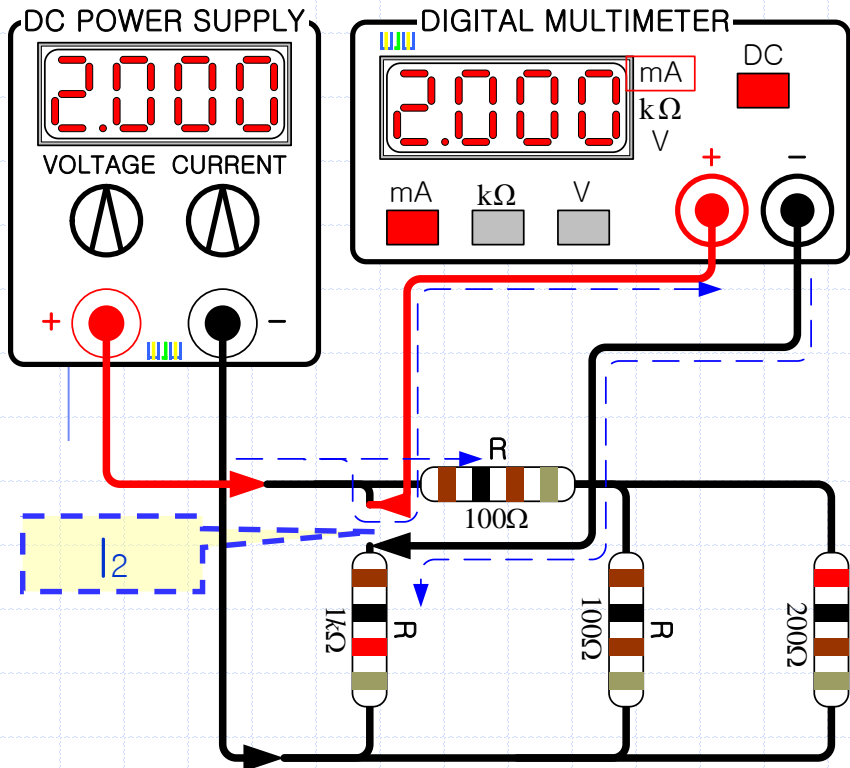


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GND

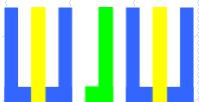
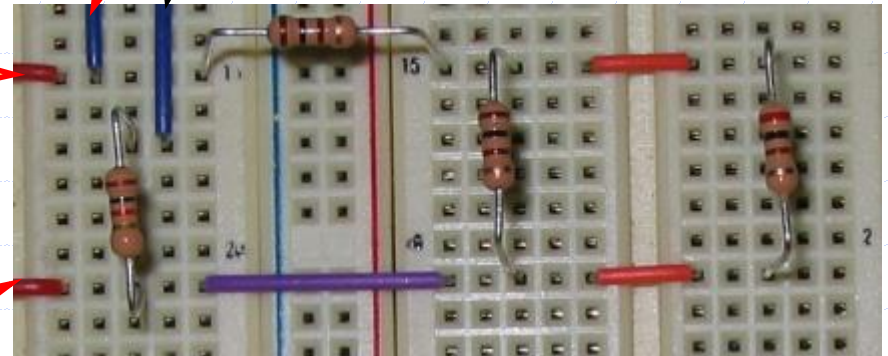


4-7C. 전류 측정

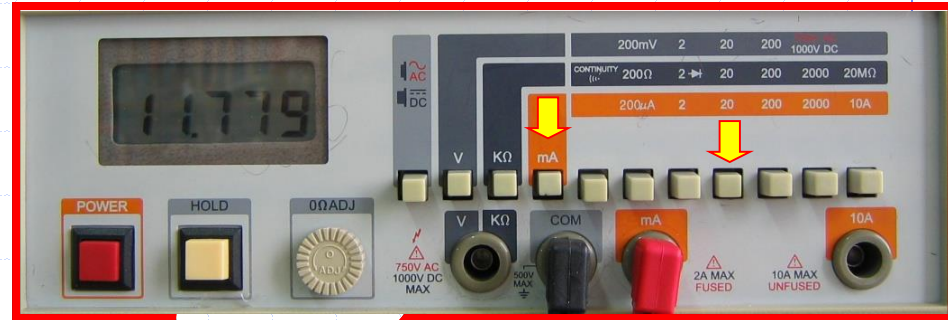
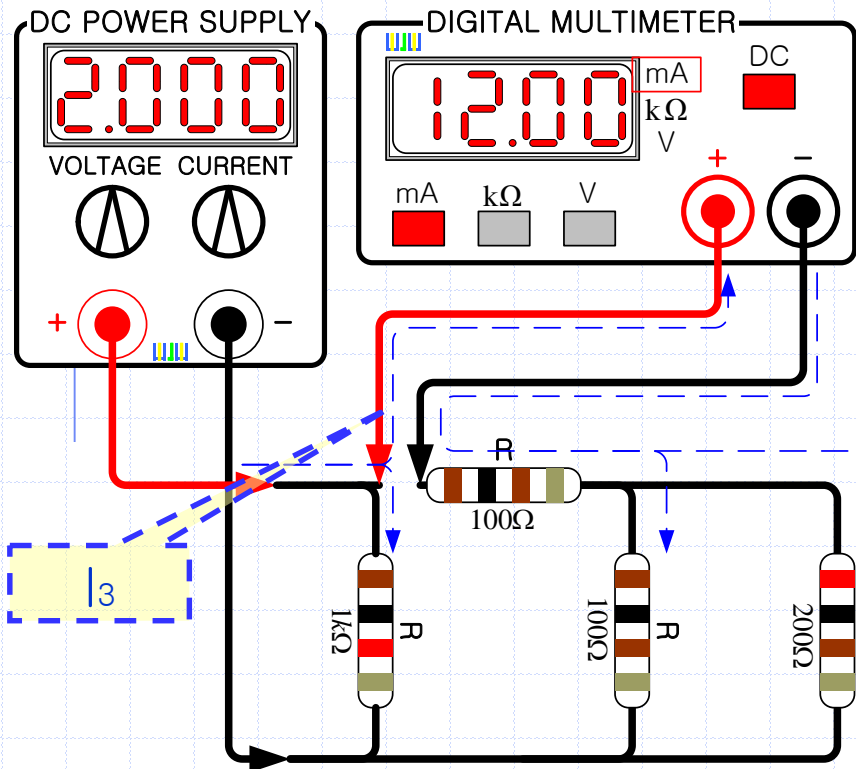


+2V

GND

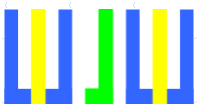
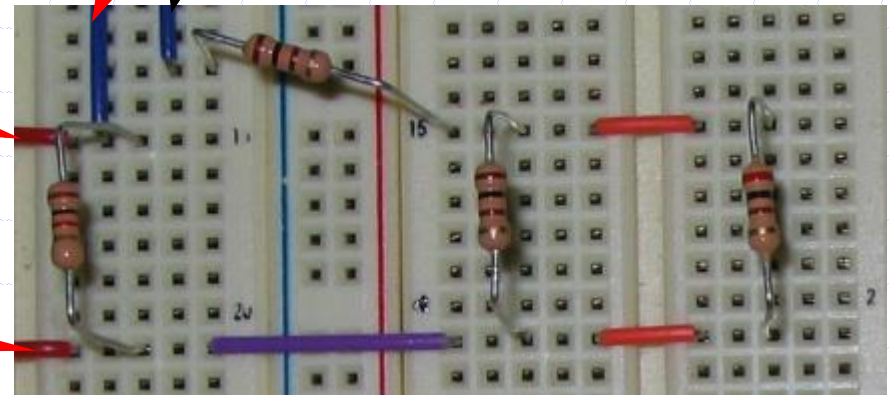


4-7C. 전류 측정

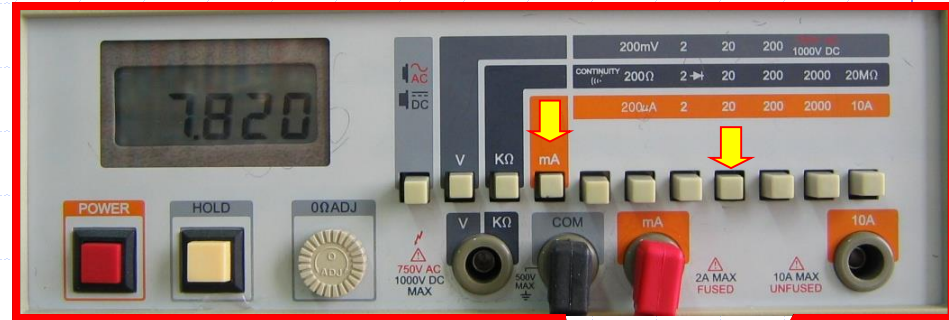
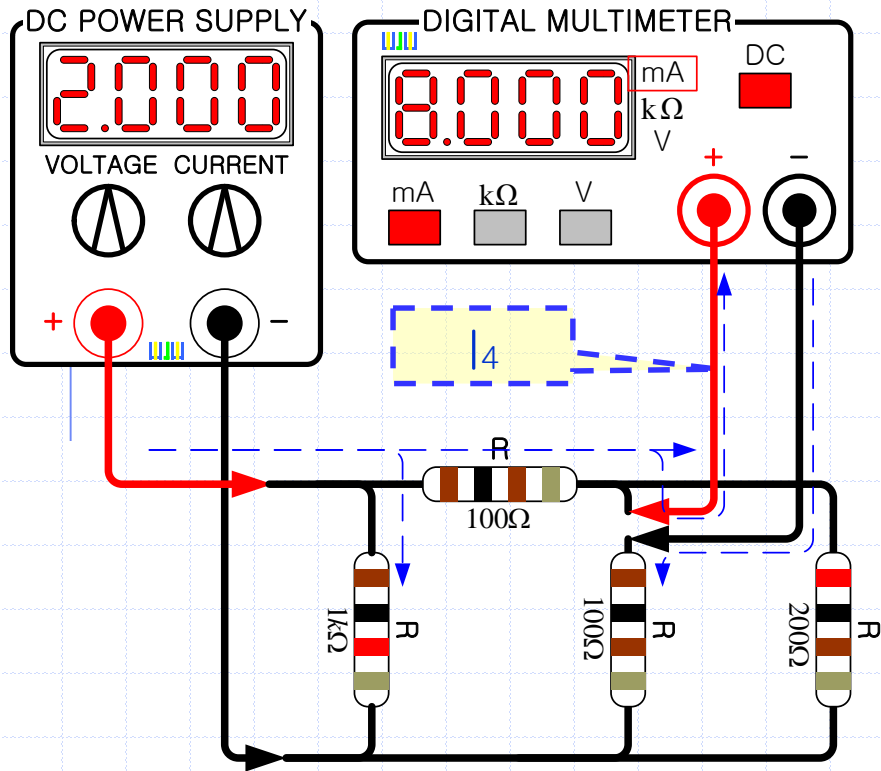


+2V

GND

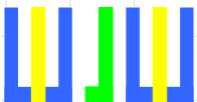
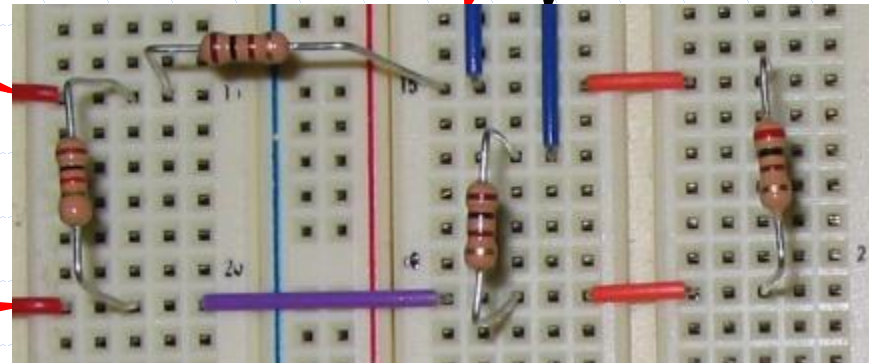


4-7C. 전류 측정

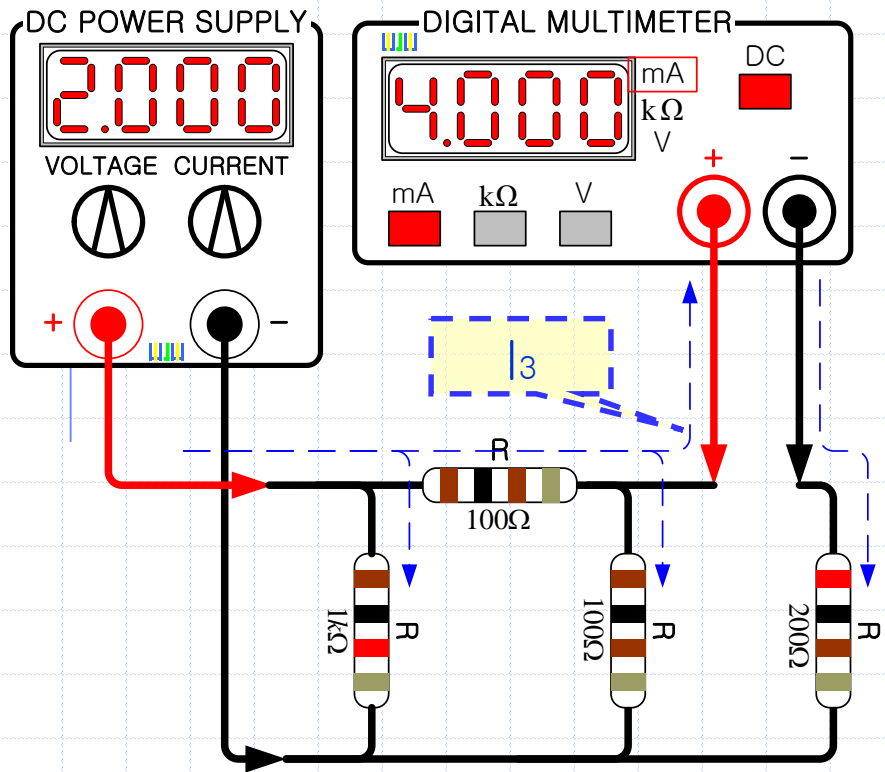


+2V

GND

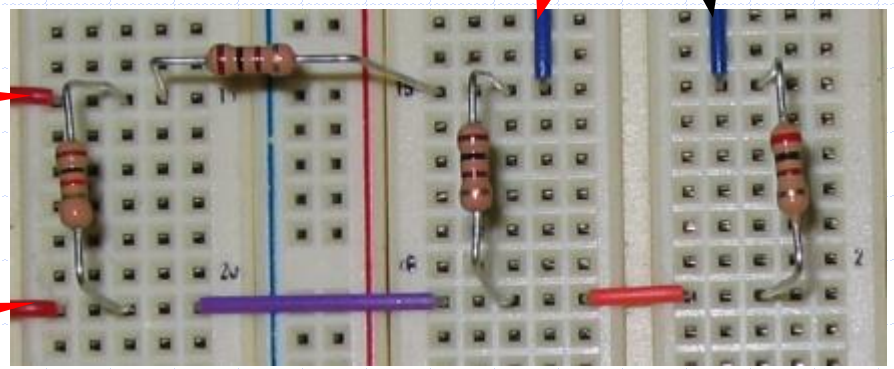


4-7C. 전류 측정

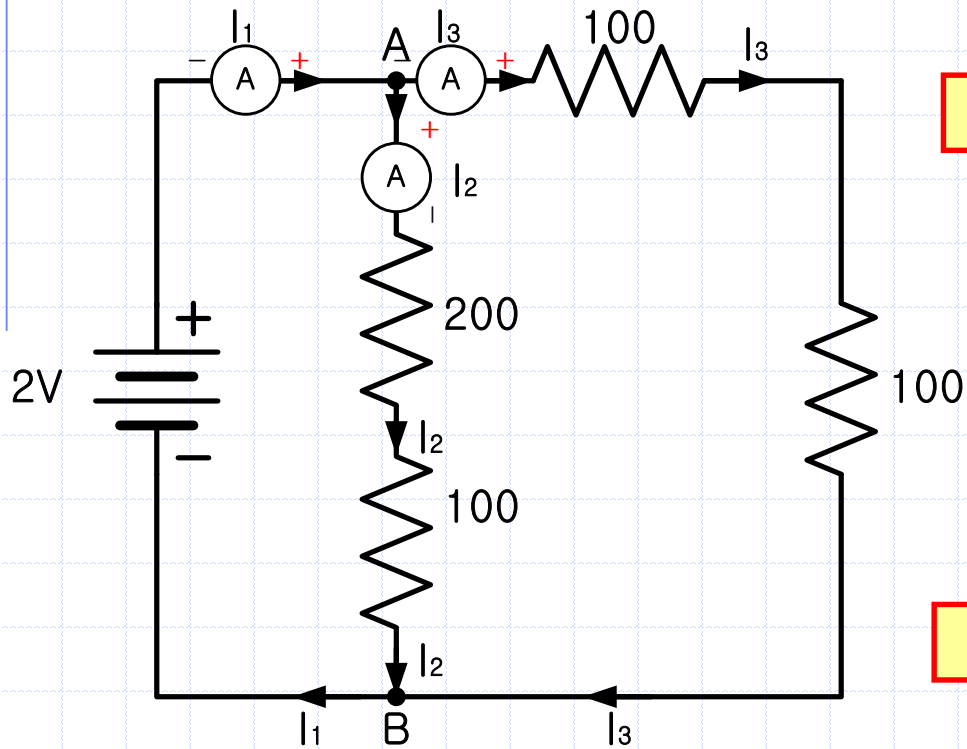


+2V

GND

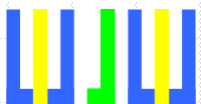
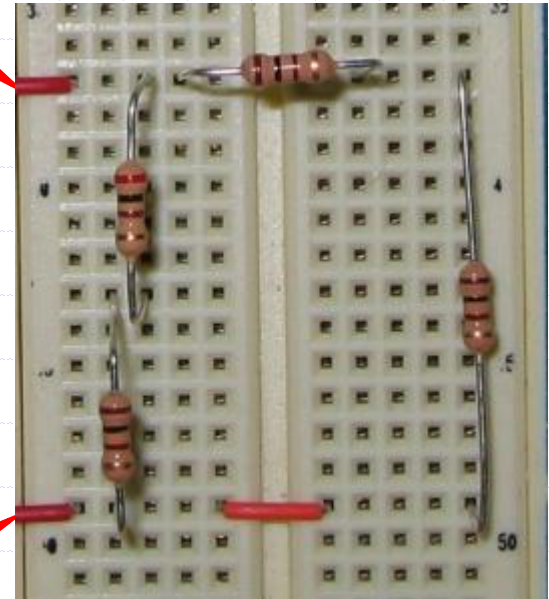


4-7D. 전류 측정

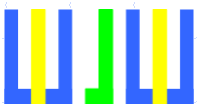
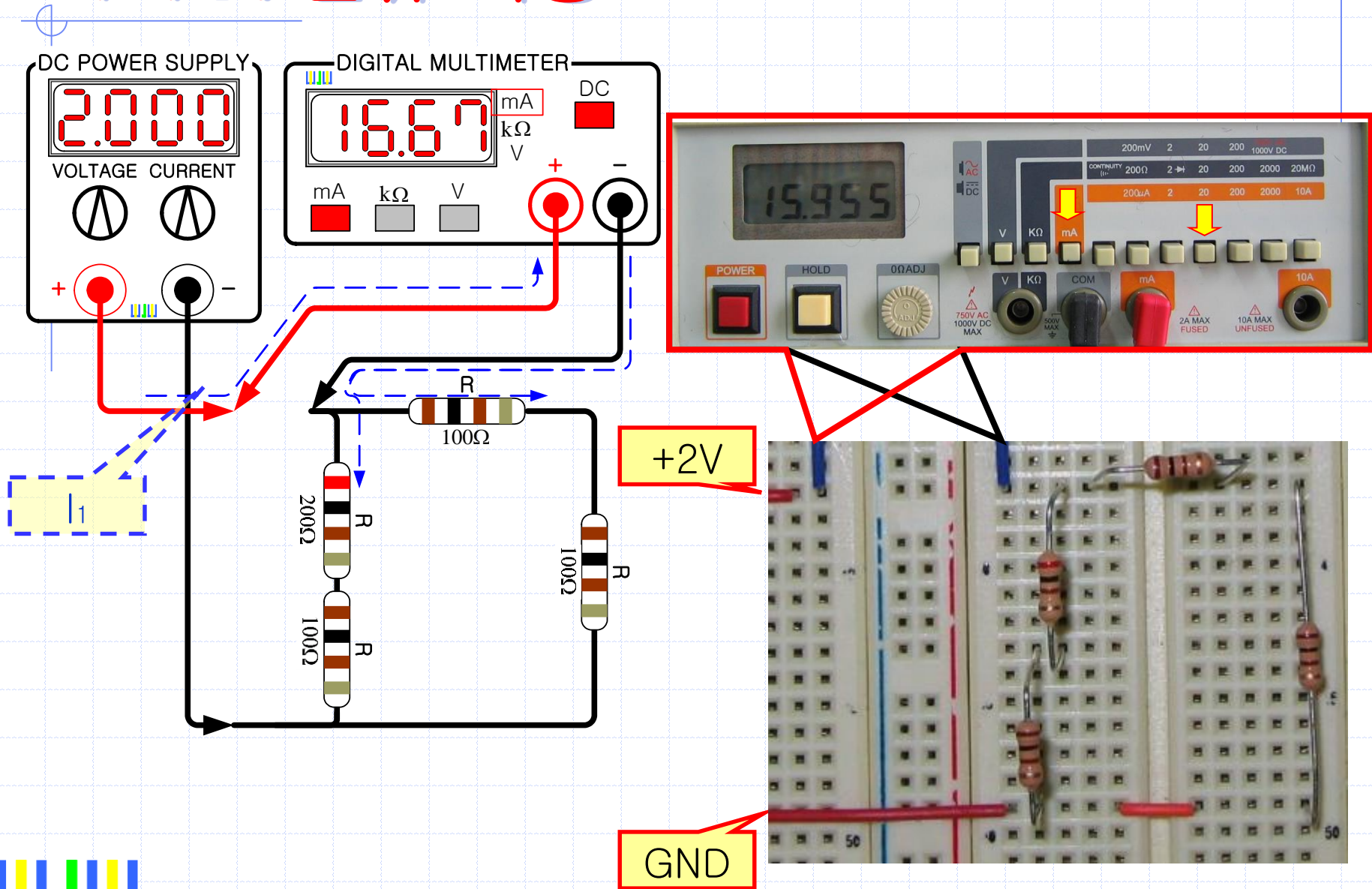


+2V

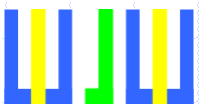
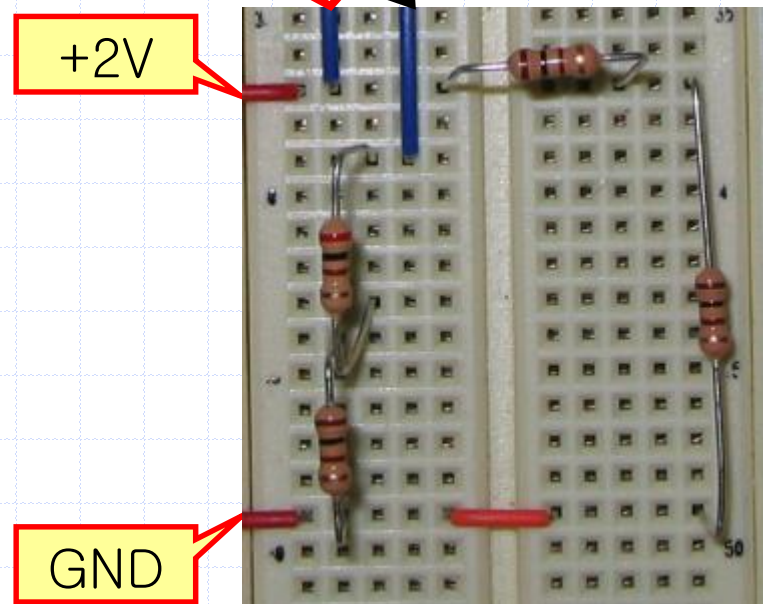
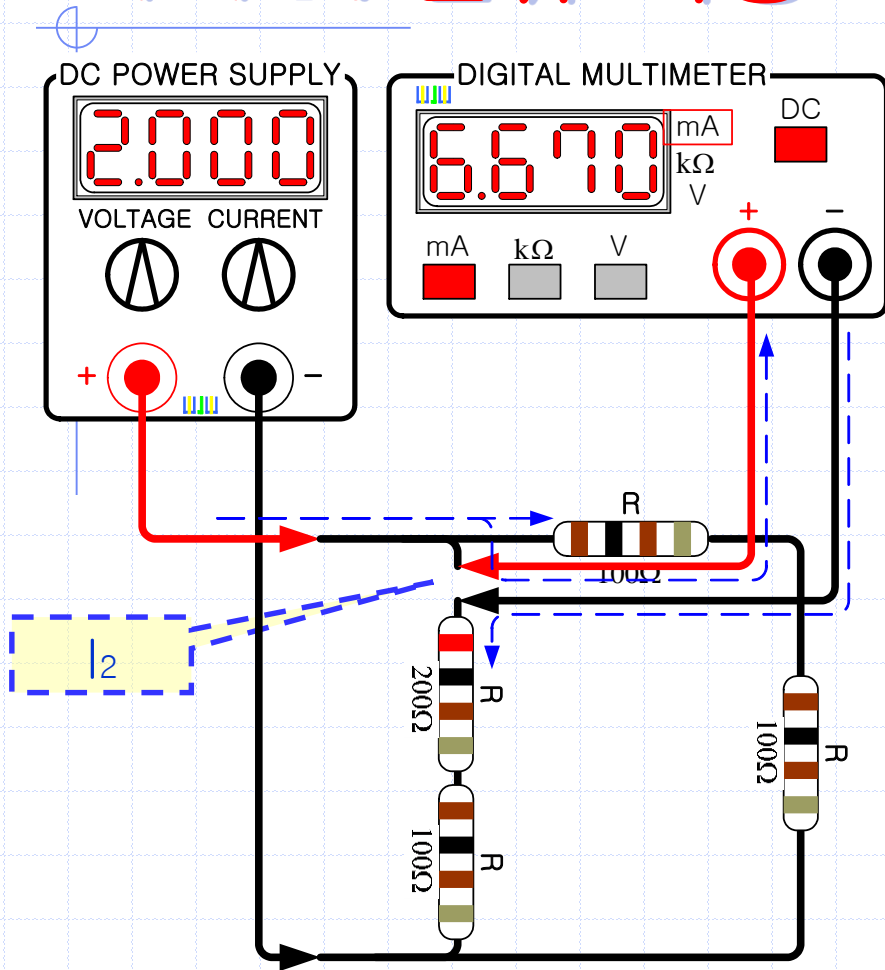
GND



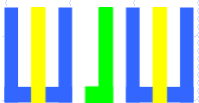
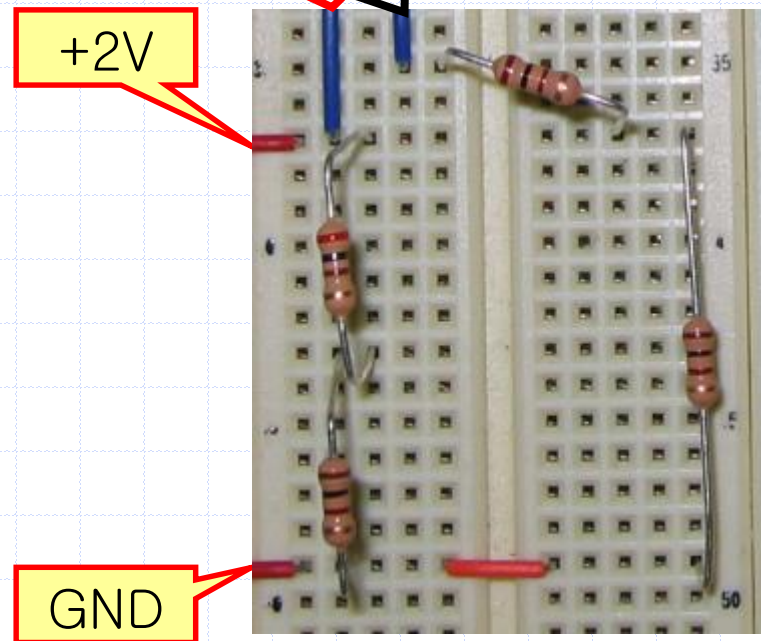
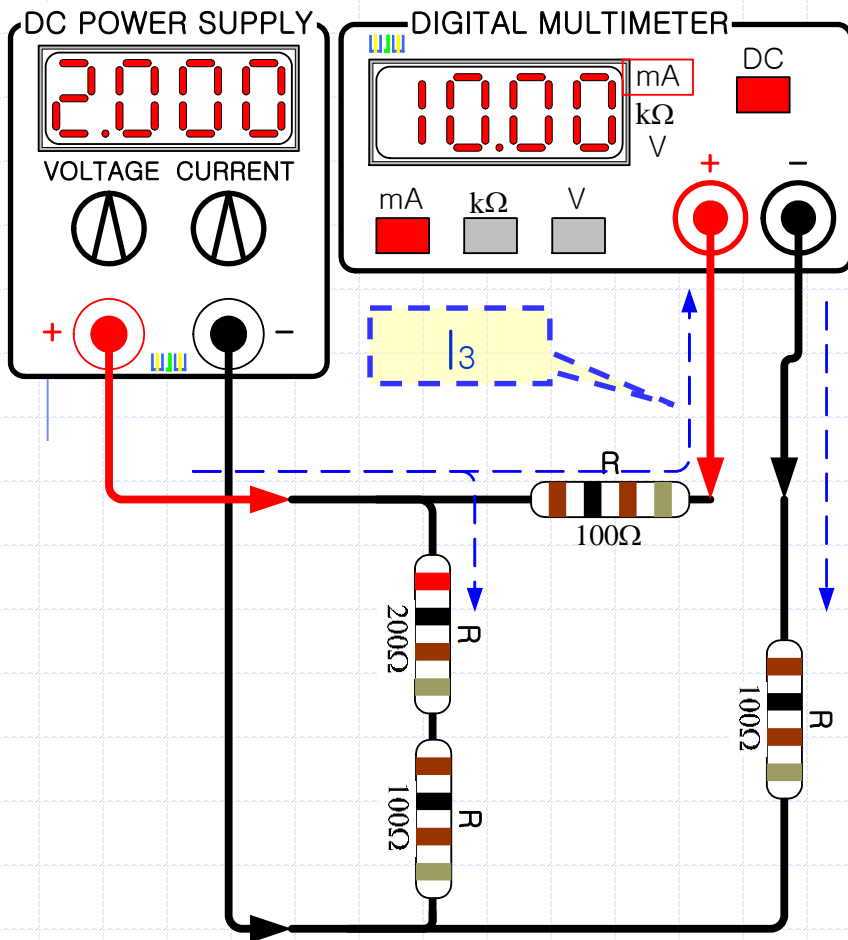
4-7D. 전류 측정



4-7D. 전류 측정

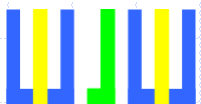
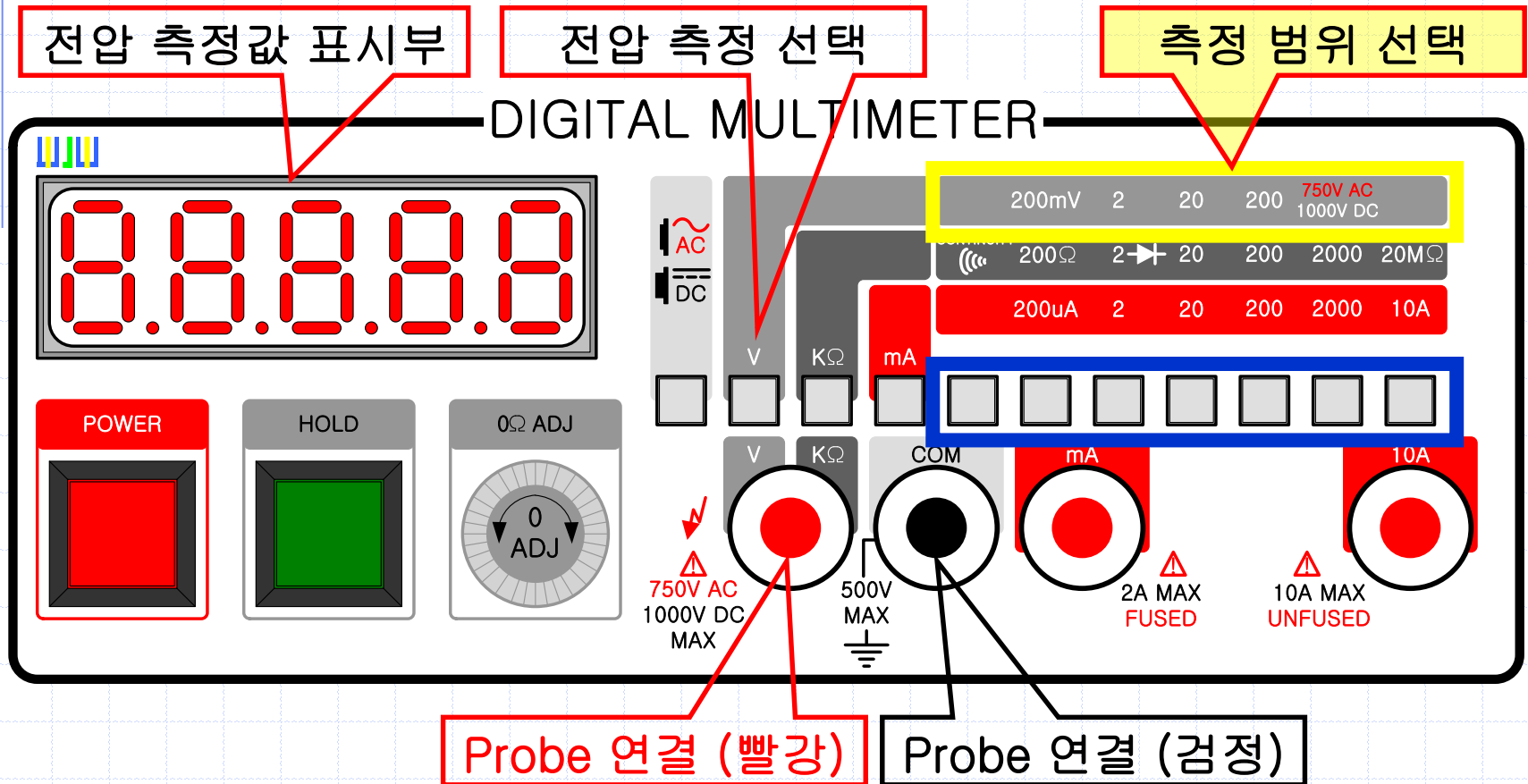


4-7D. 전류 측정



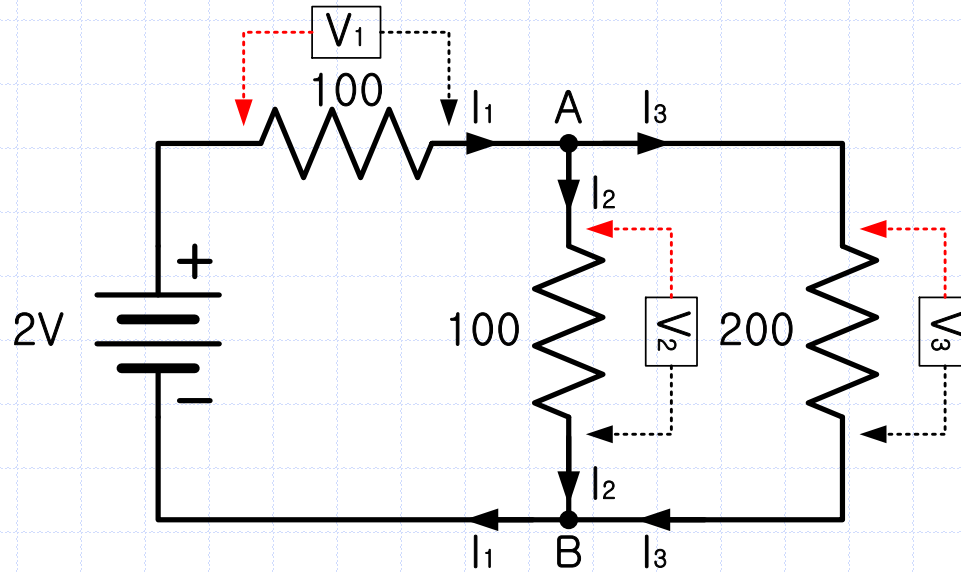
4-8. 디지털 멀티미터 (DMM)-전압 측정

- ✓ DMM 사용하기 (전압 측정)

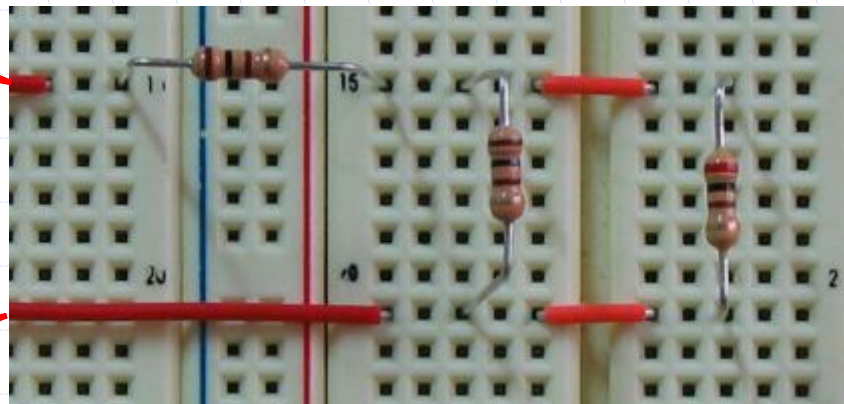


4-9A. 전압 측정

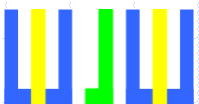
- ✓ 전압의 측정 방법 : 회로와 병렬로 연결하여 측정



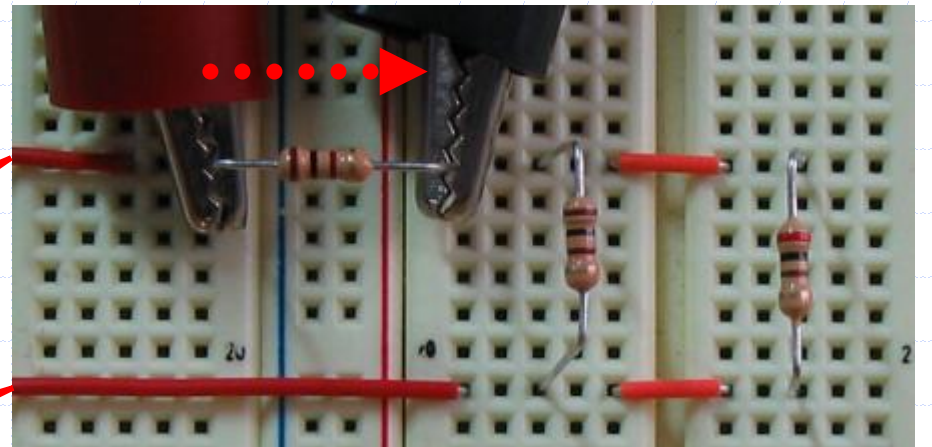
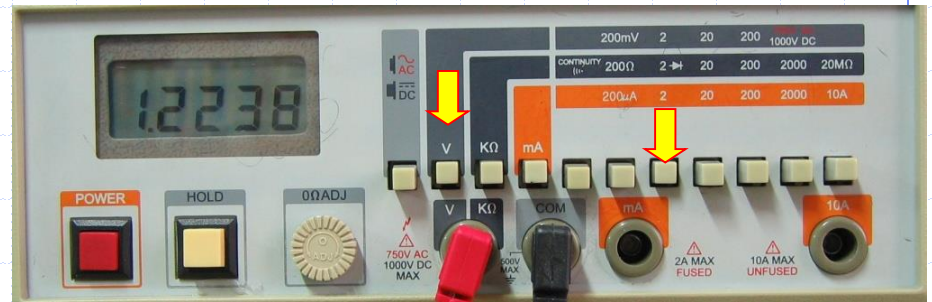
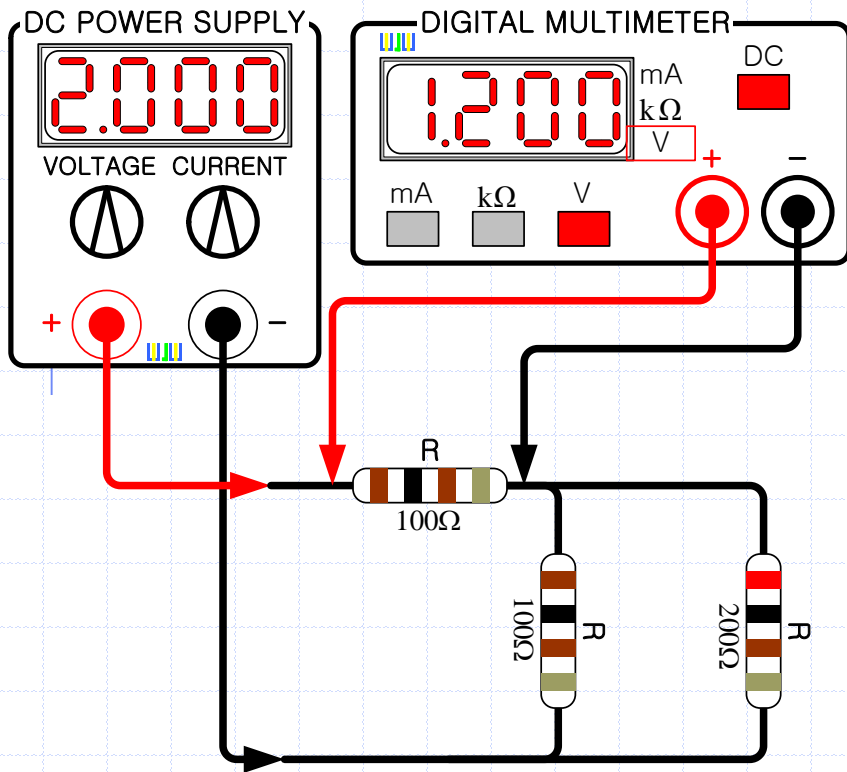
+2V



GND

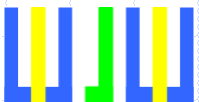


4-9A. 전압 측정

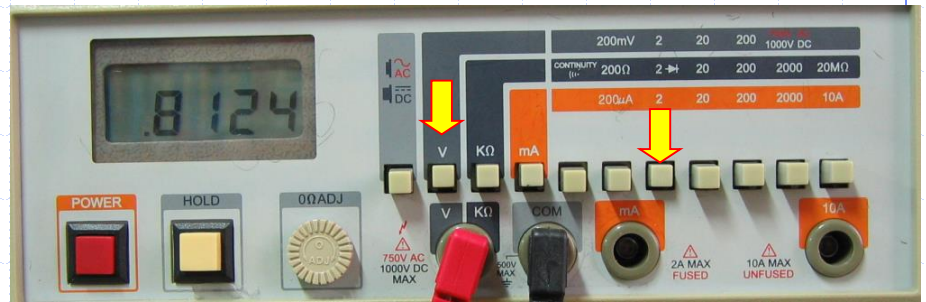
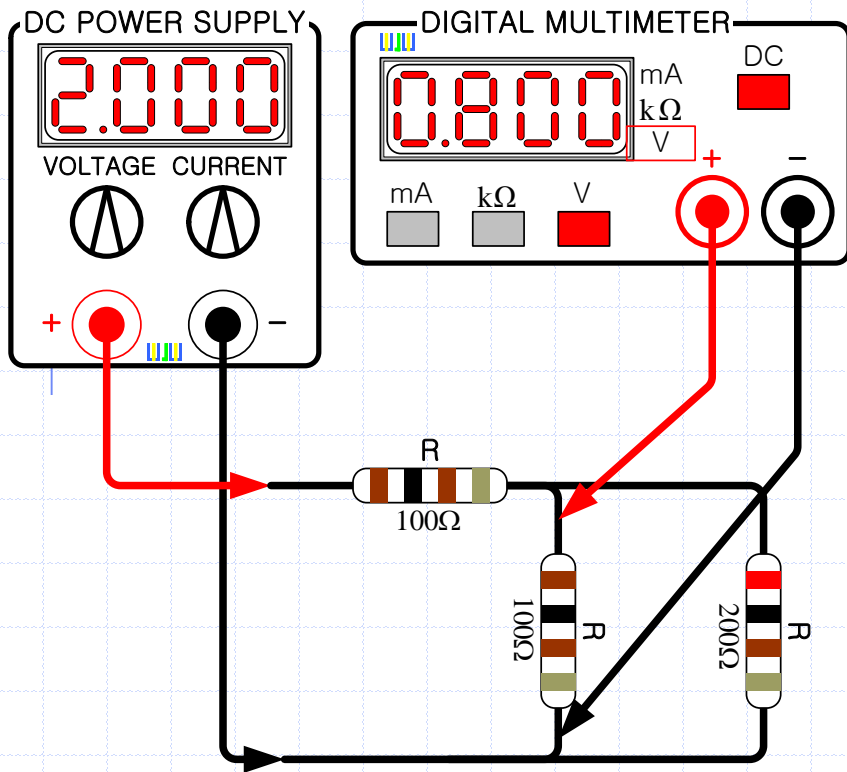


+2V

GND

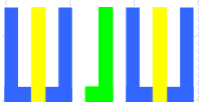
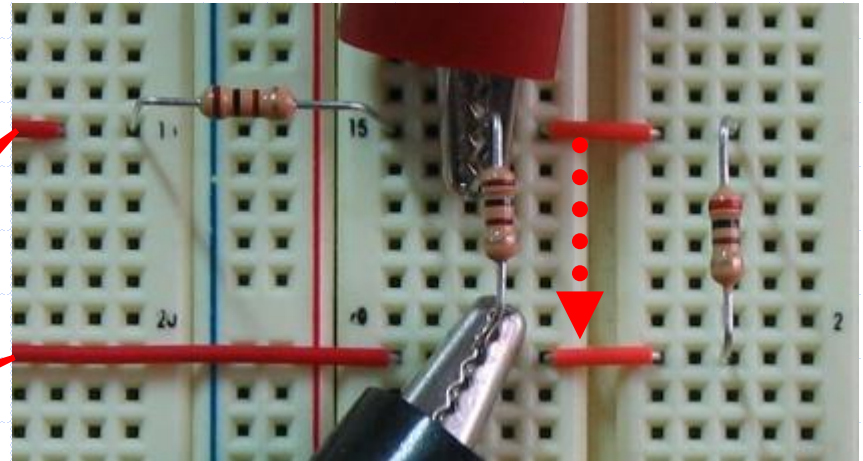


4-9A. 전압 측정

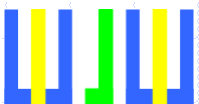
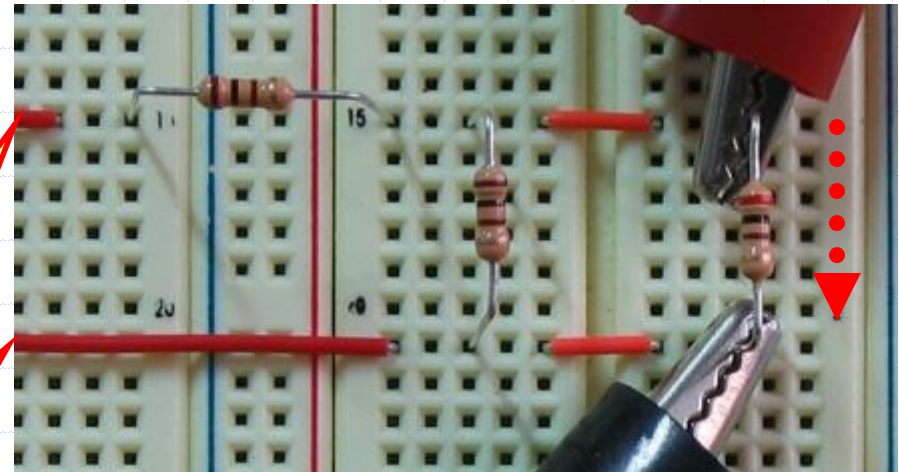
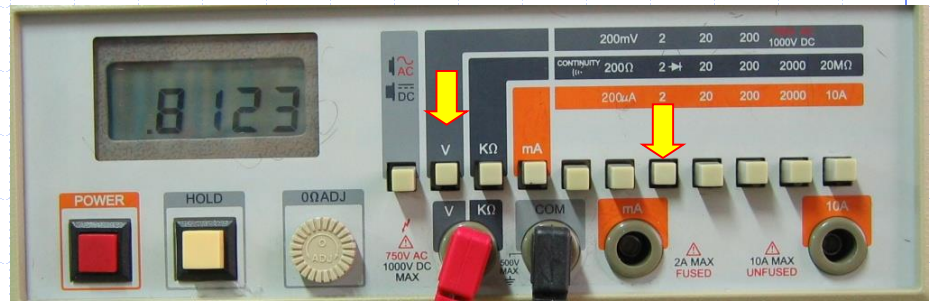
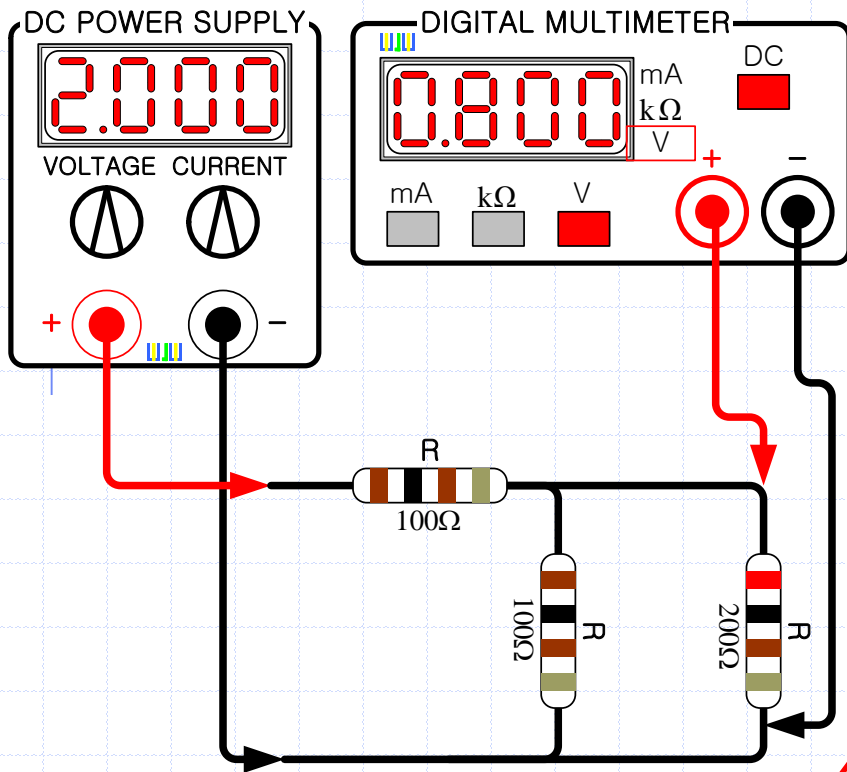


+2V

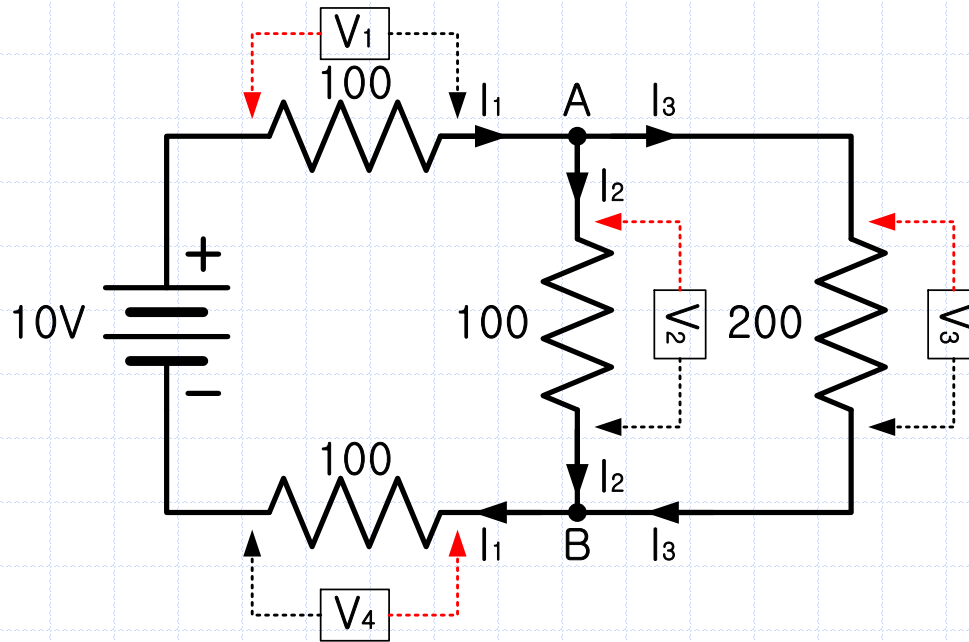
GND



4-9A. 전압 측정

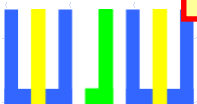
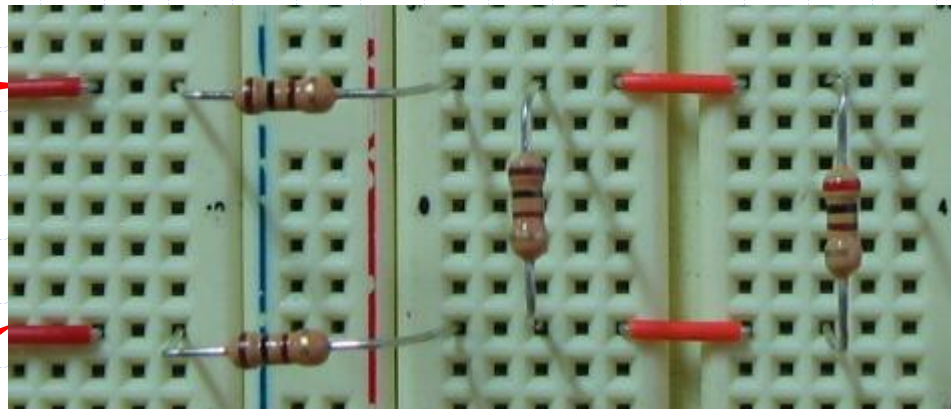


4-9B. 전압 측정

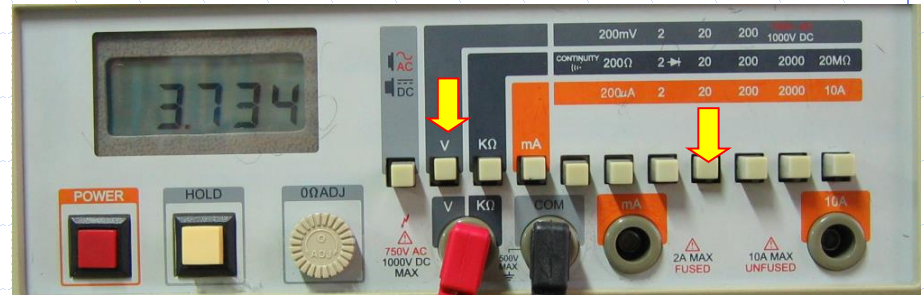
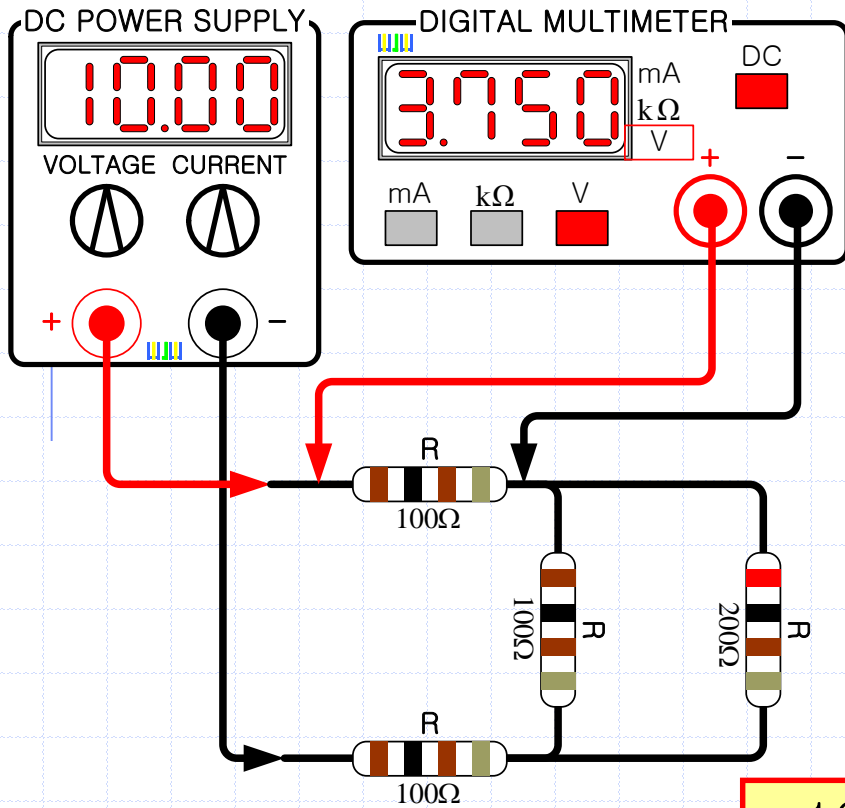


+10V

GND

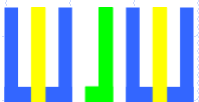
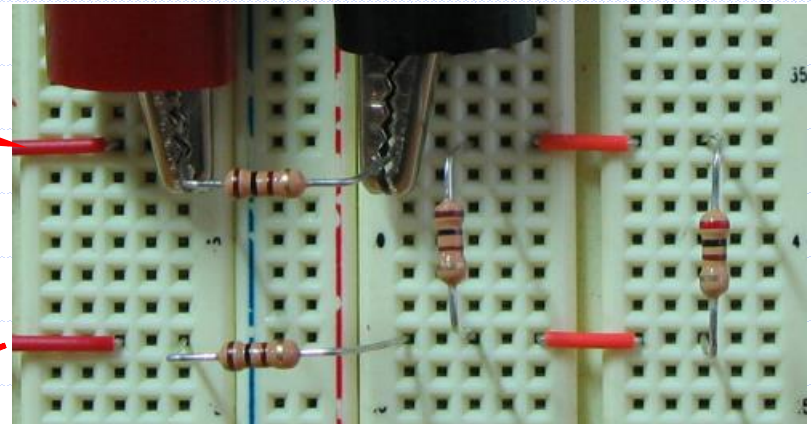


4-9B. 전압 측정

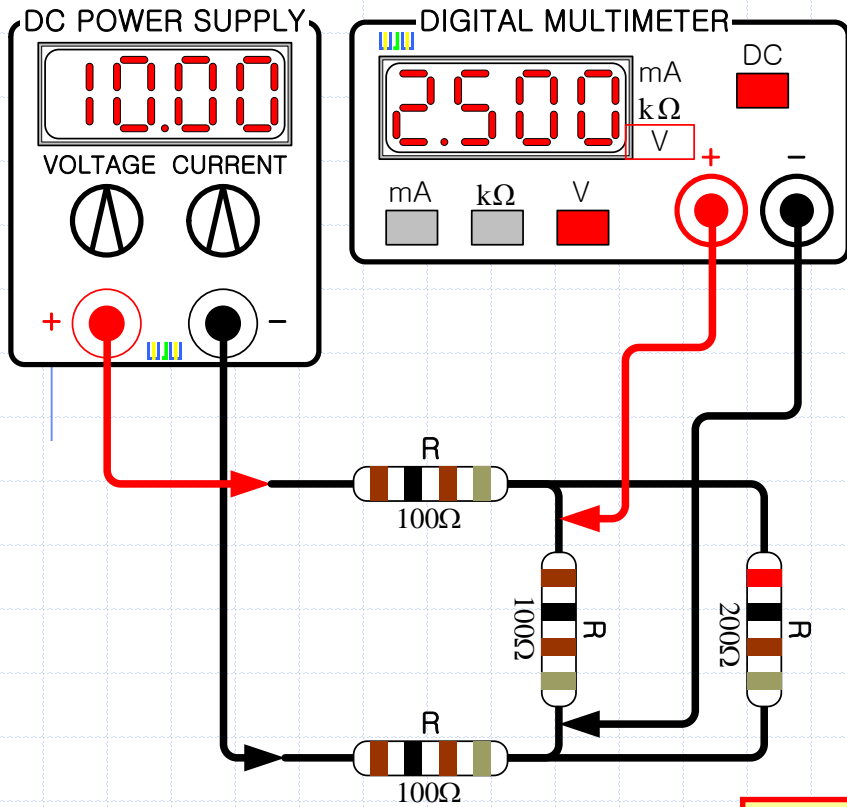


+10V

GND

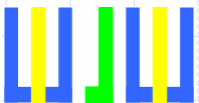
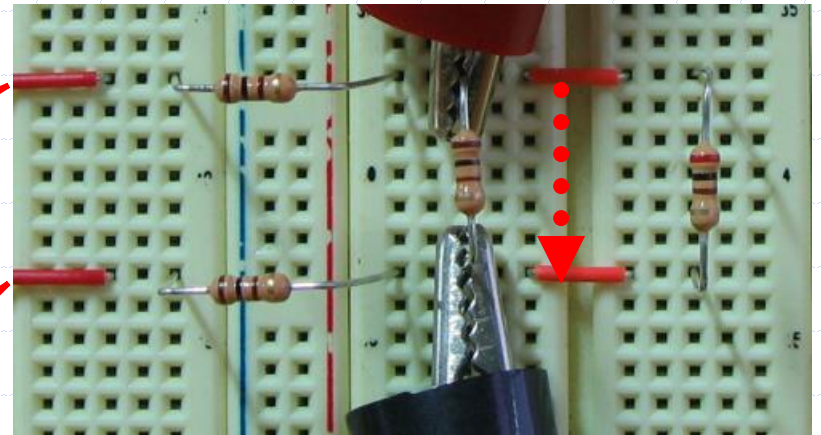


4-9B. 전압 측정

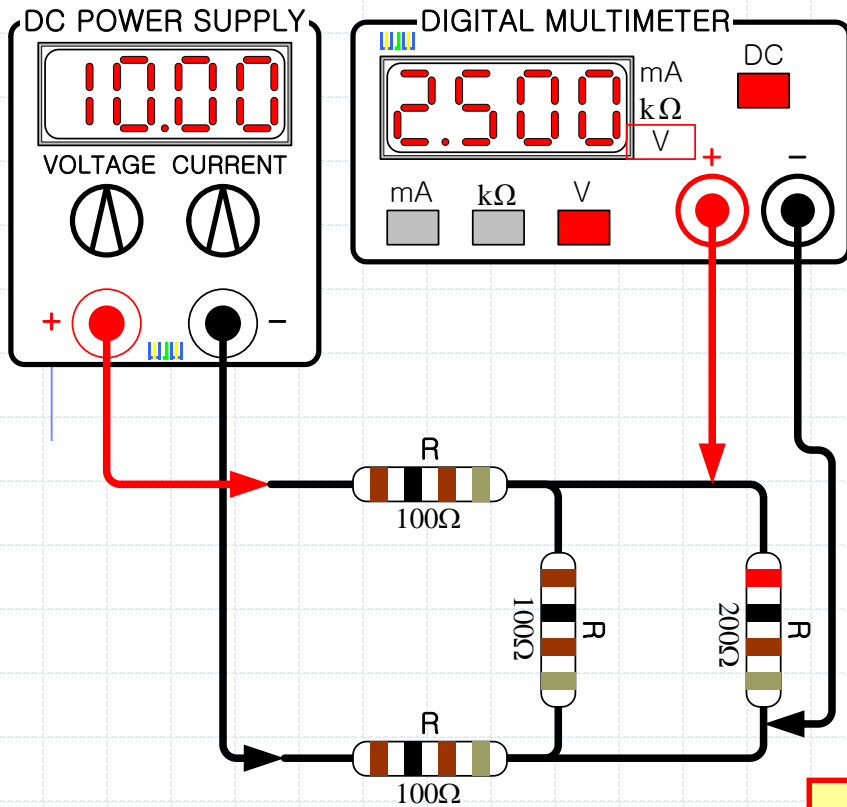


+10V

GND

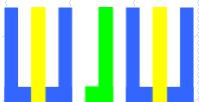
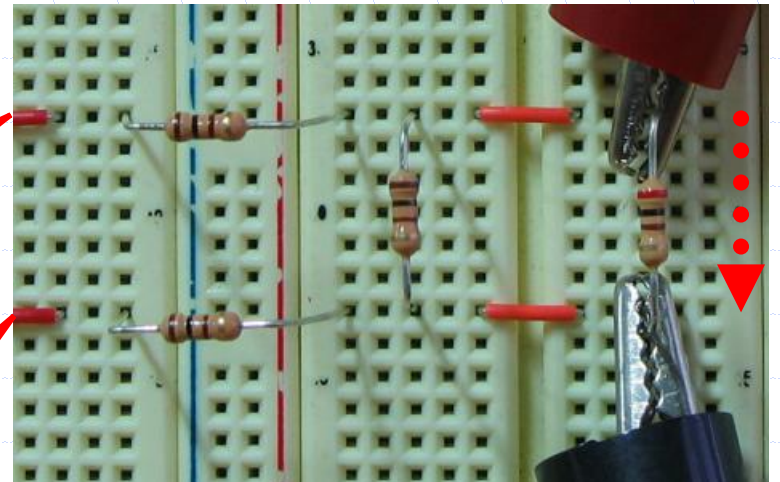


4-9B. 전압 측정

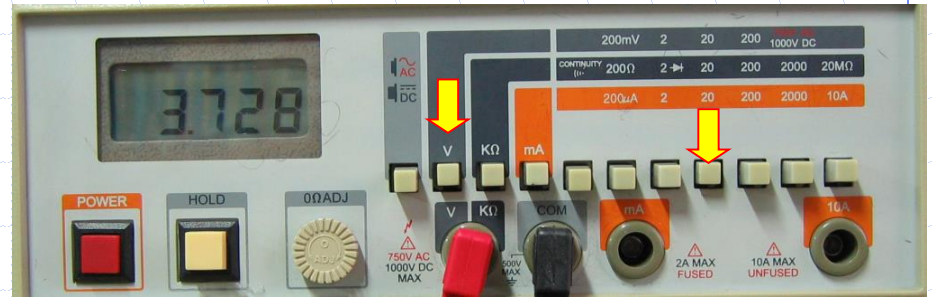
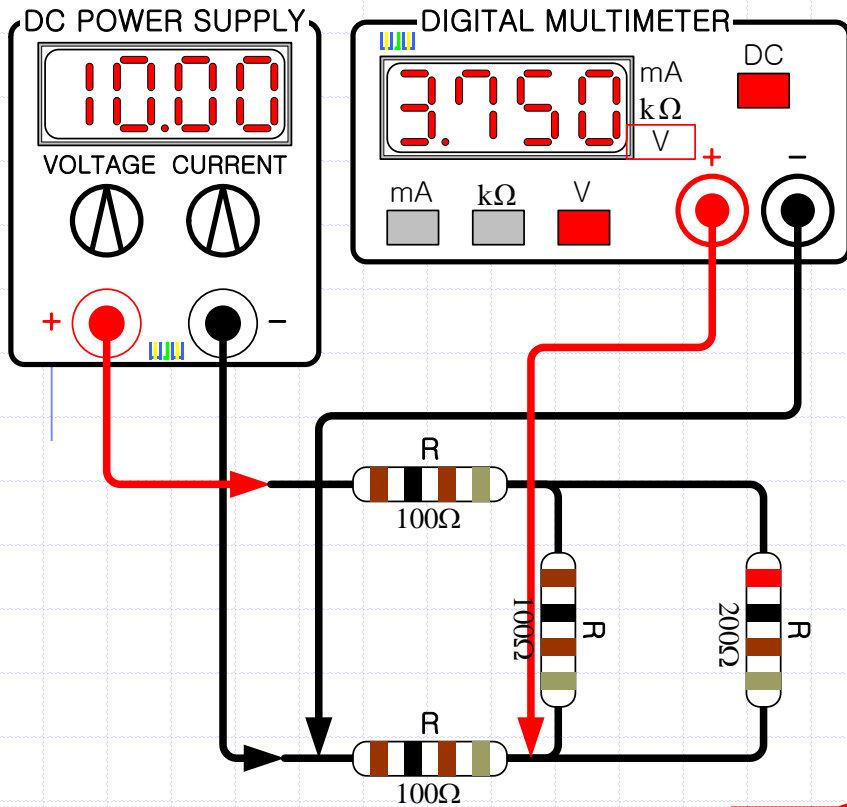


+10V

GND

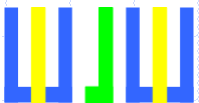
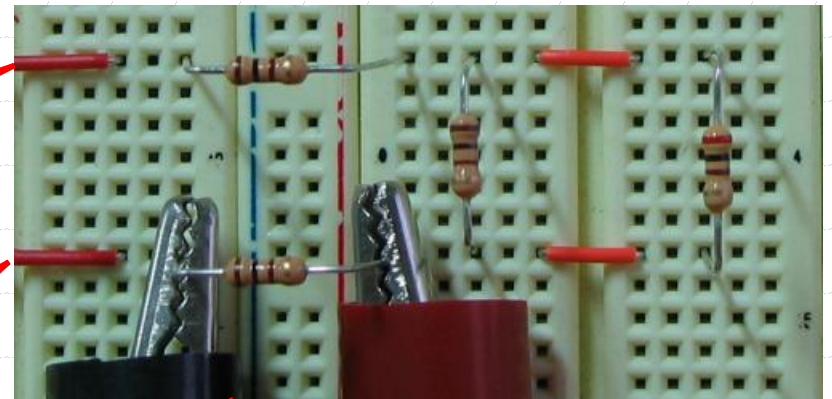


4-9B. 전압 측정

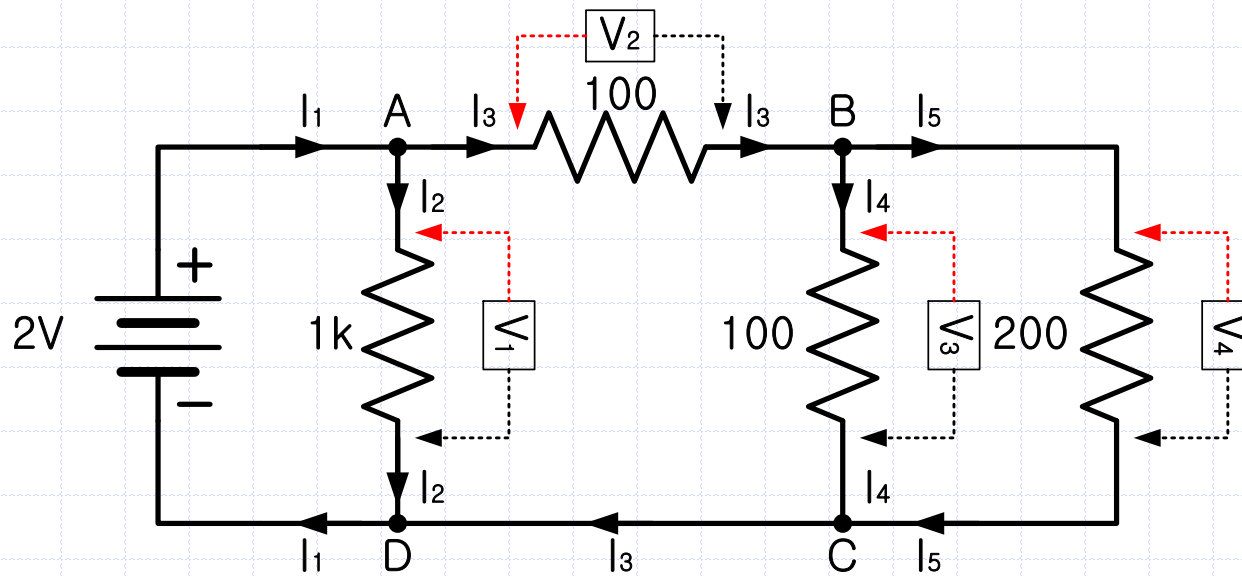


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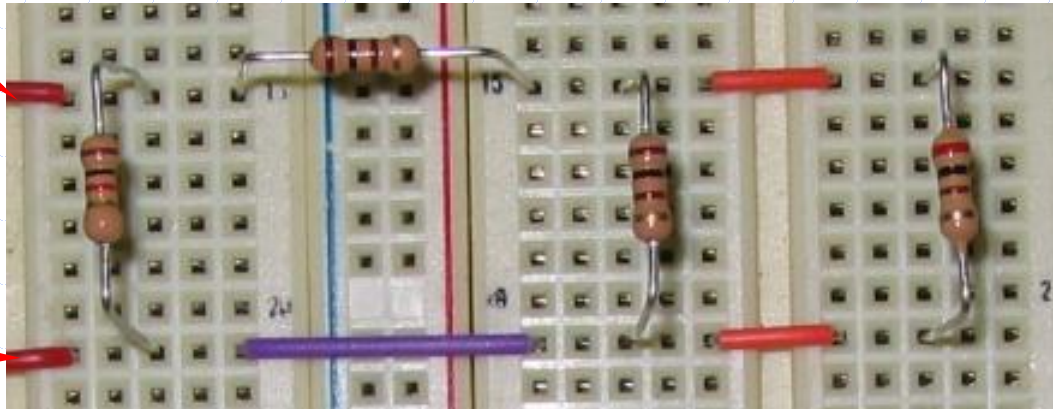
GND



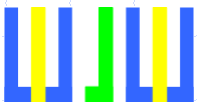
4-9C. 전압 측정



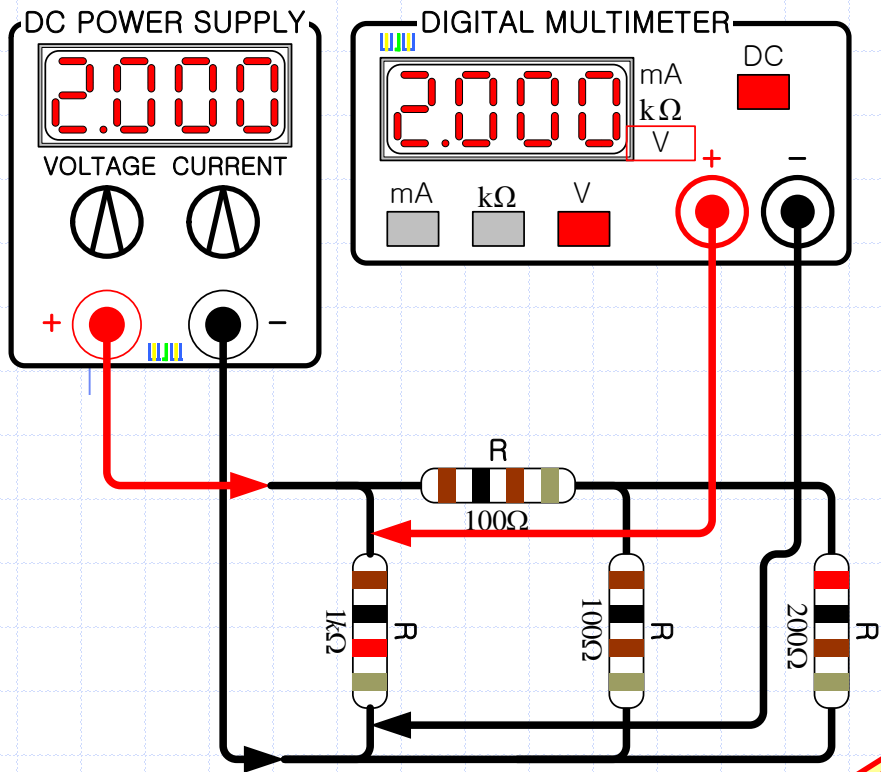
+2V



GND

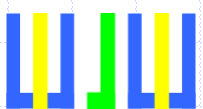
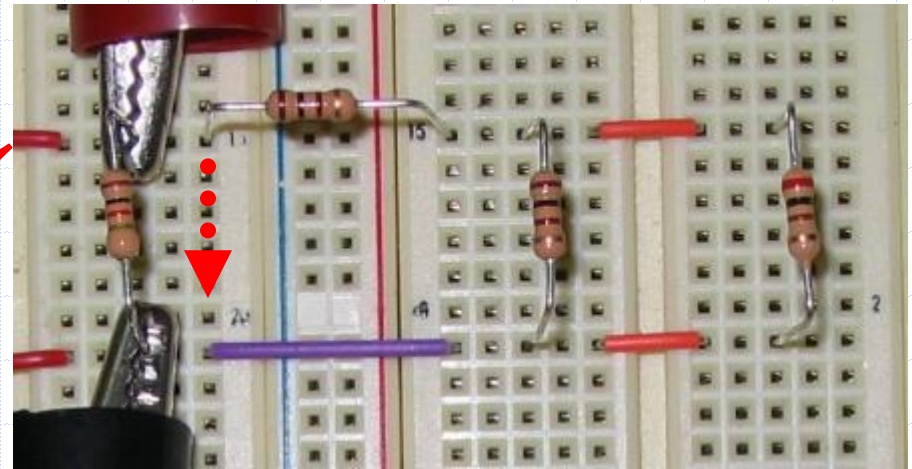
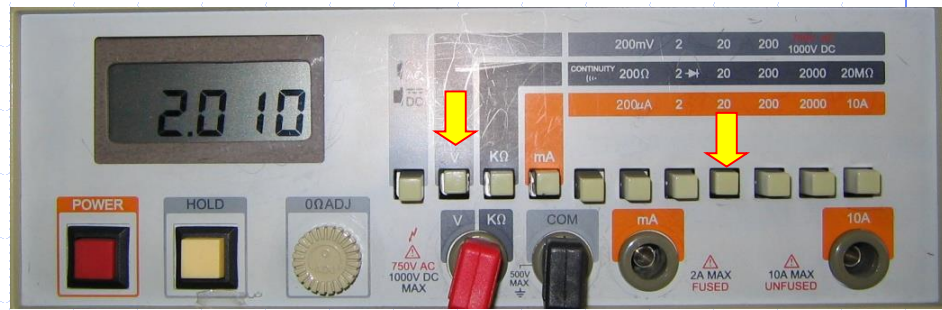


4-9C. 전압 측정

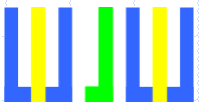
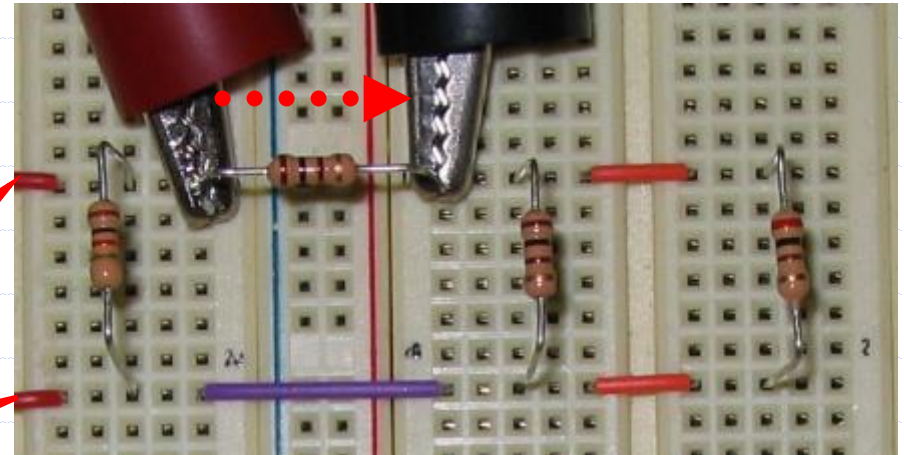
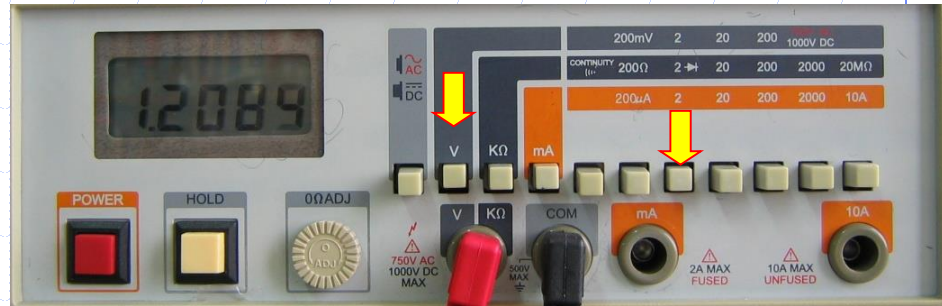
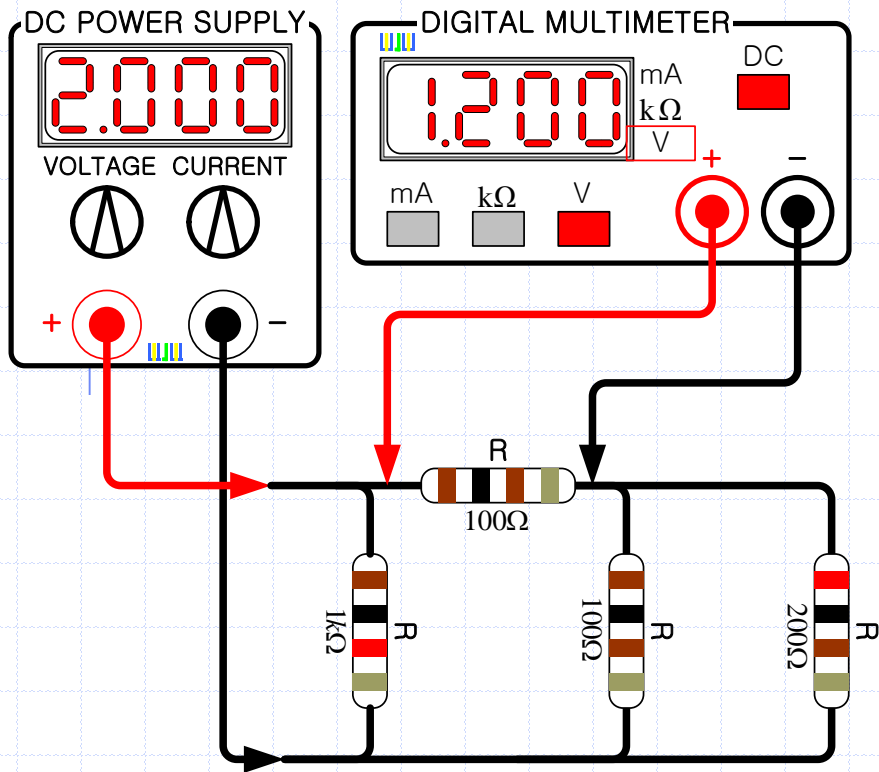


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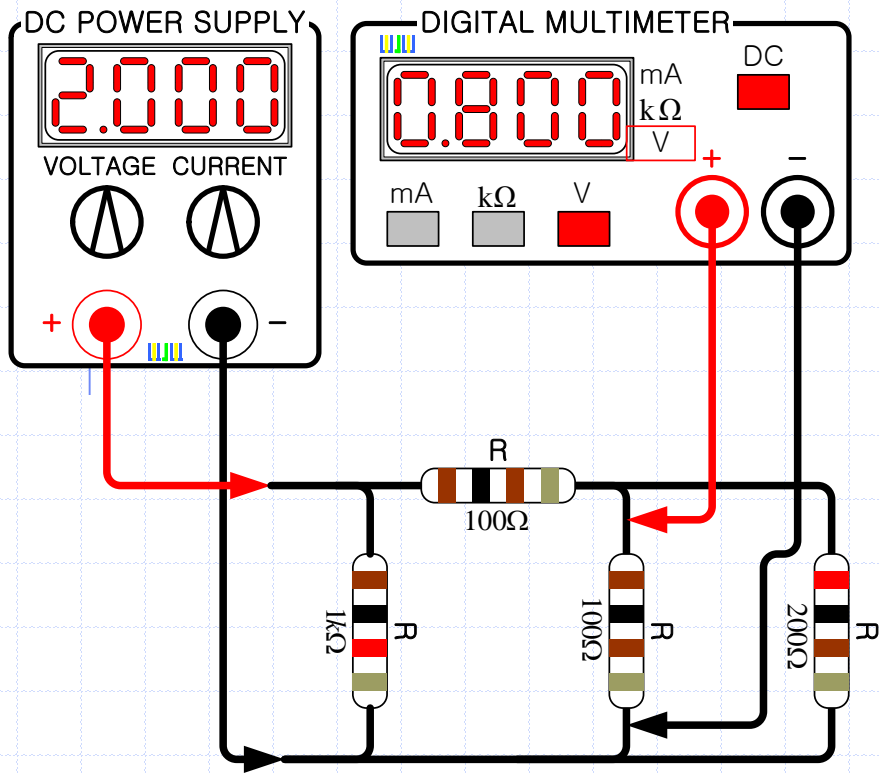
GND



4-9C. 전압 측정

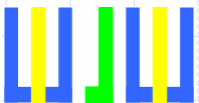
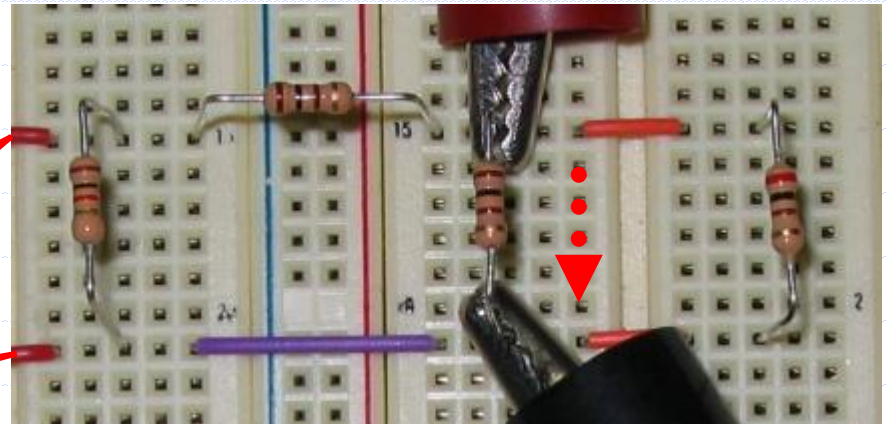


4-9C. 전압 측정

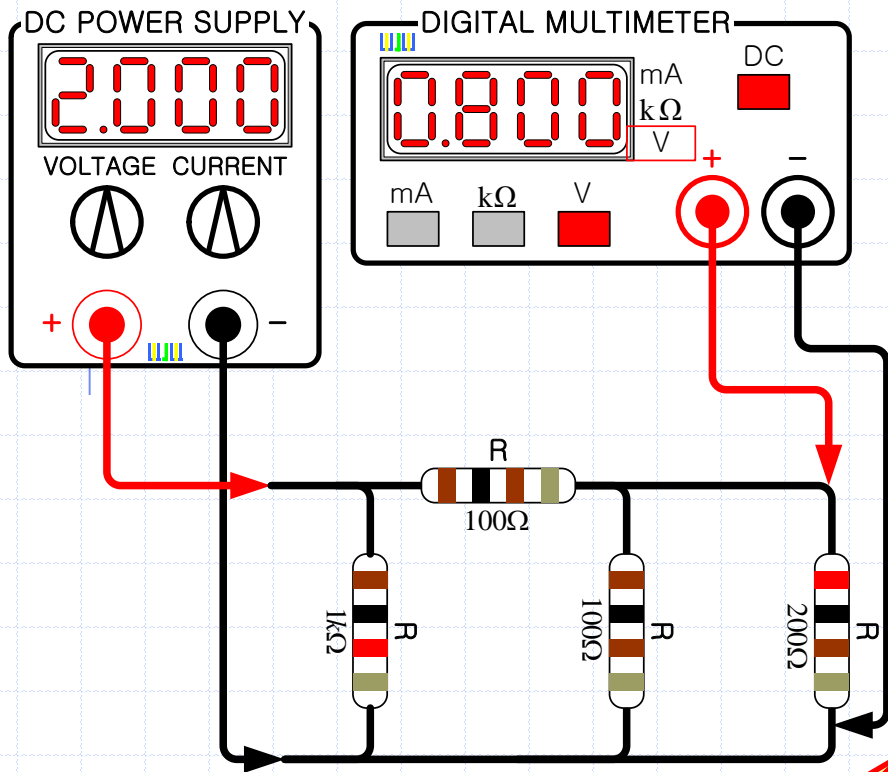


+2V

GND

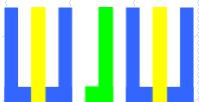
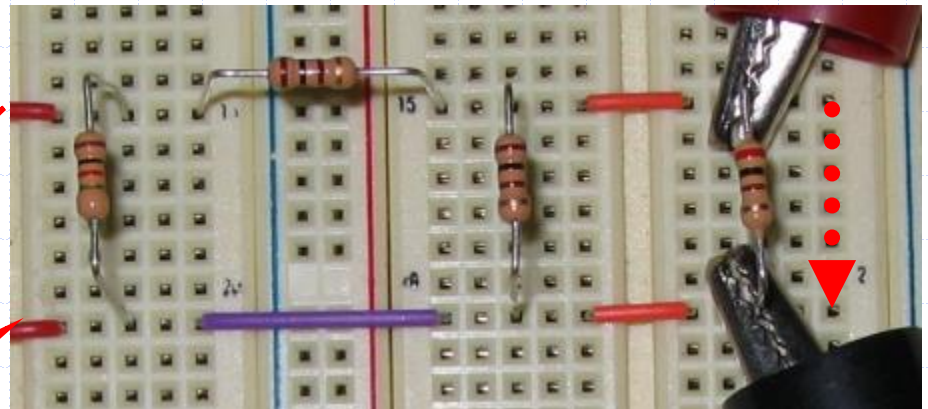
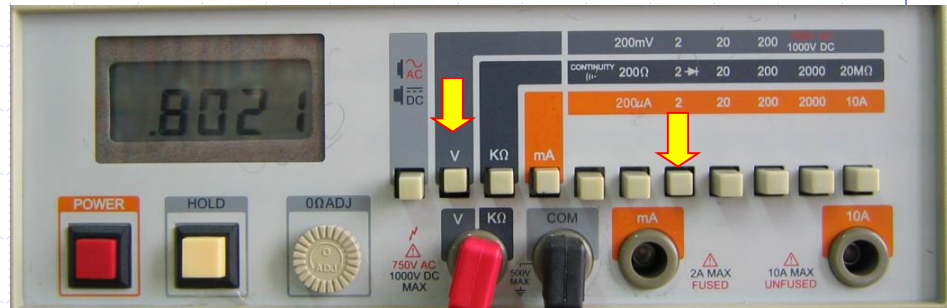


4-9C. 전압 측정

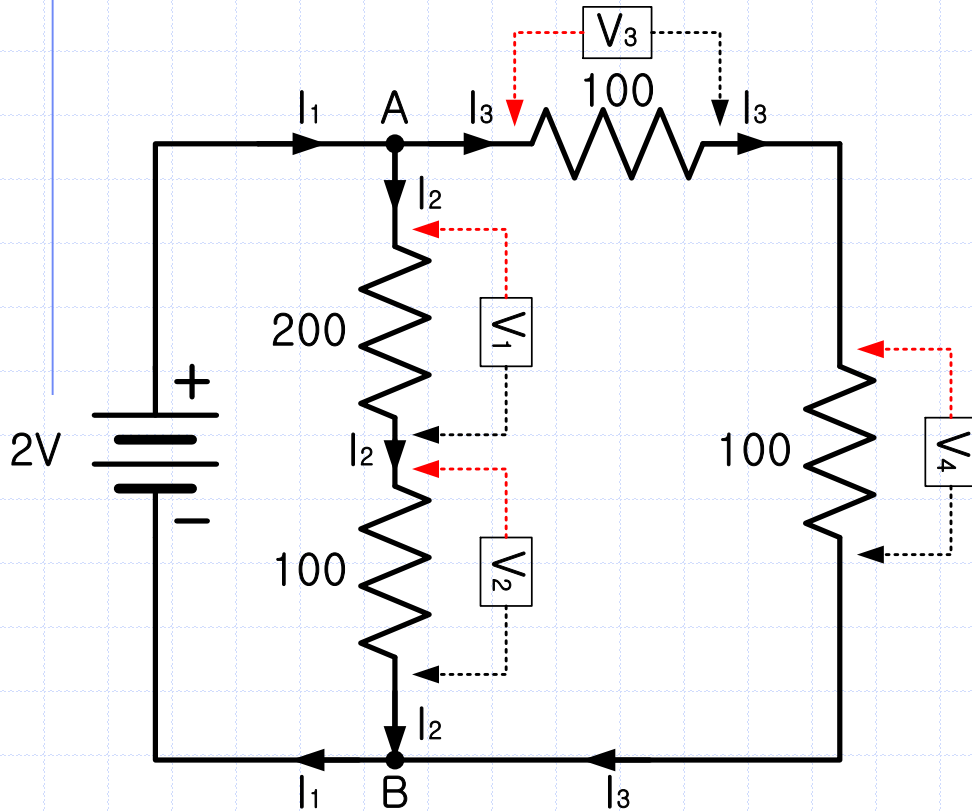


+2V

GND

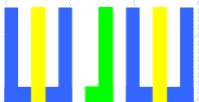
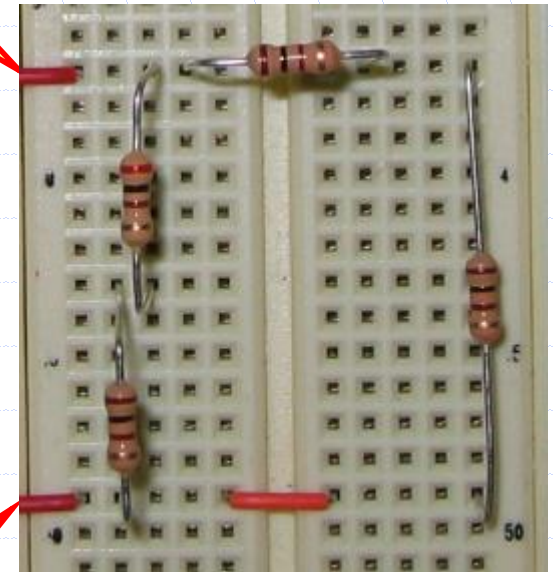


4-9D. 전압 측정

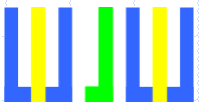
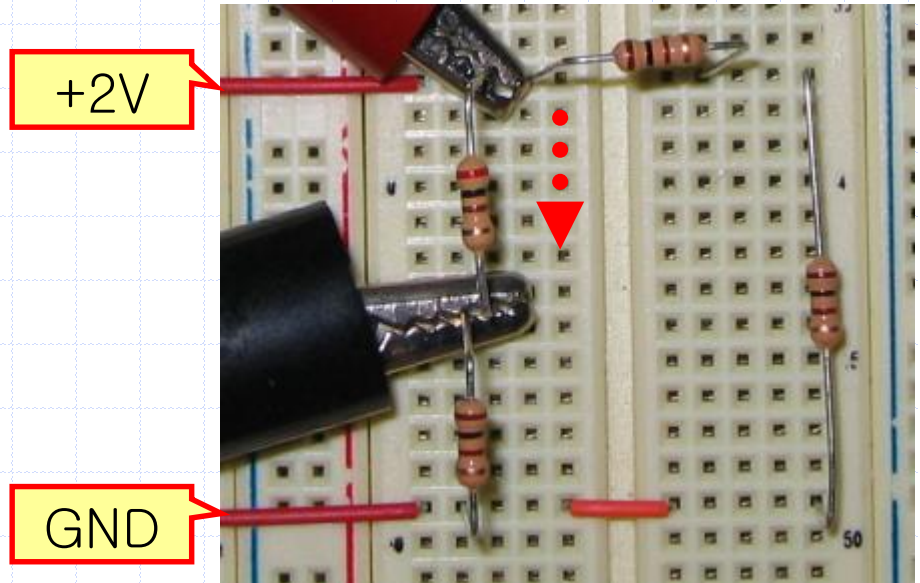
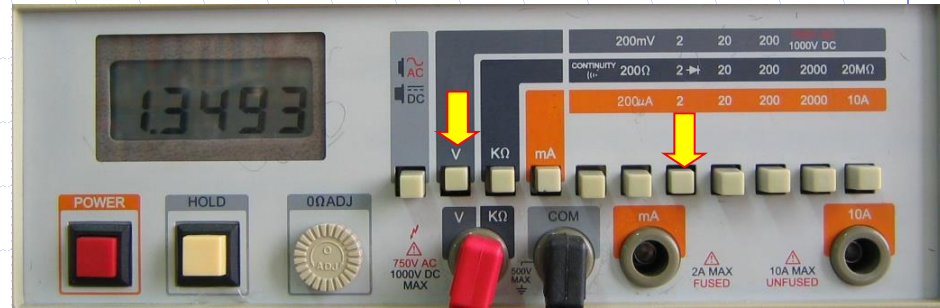
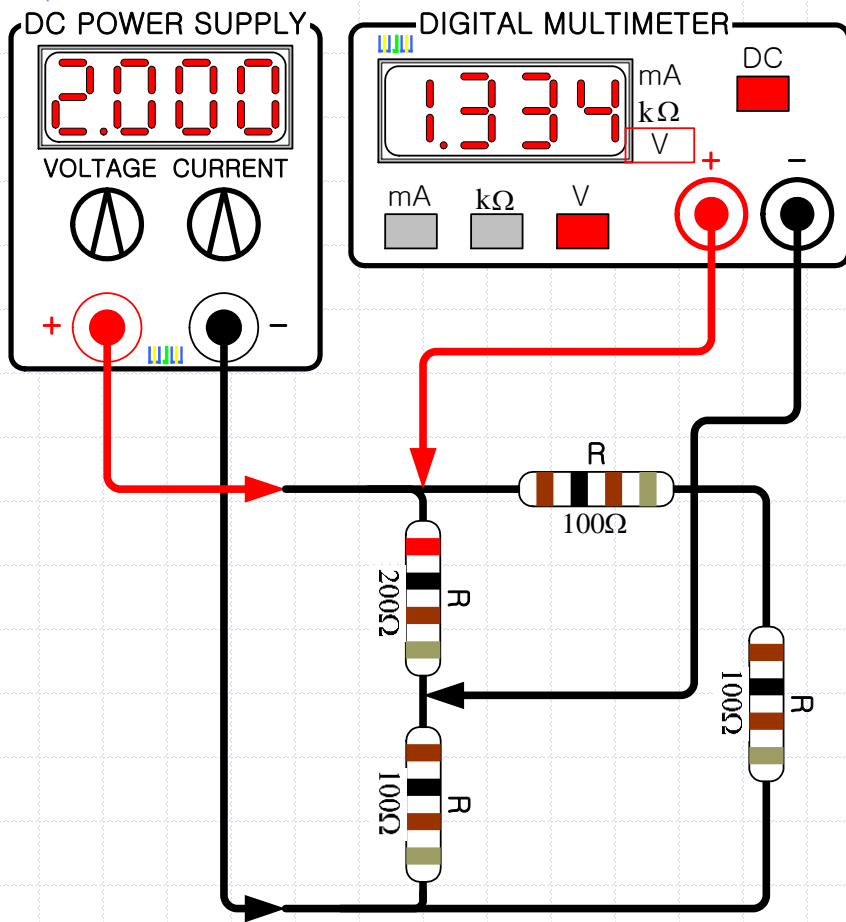


+2V

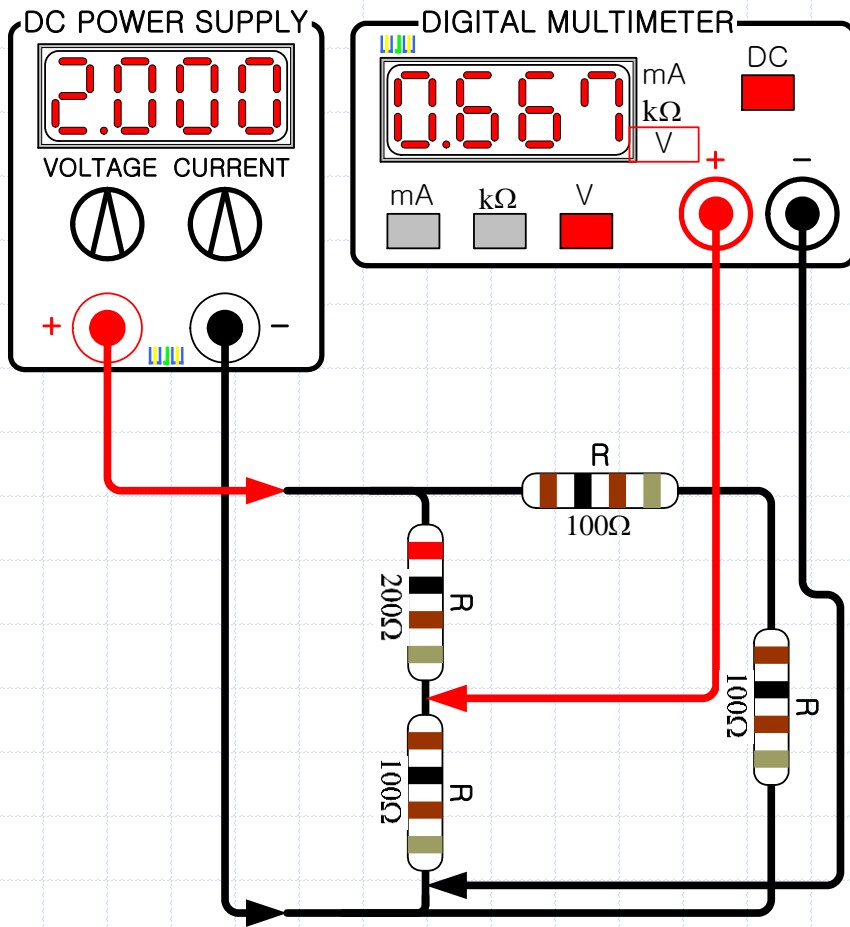
GND



4-9D. 전압 측정

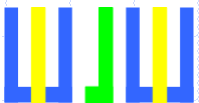
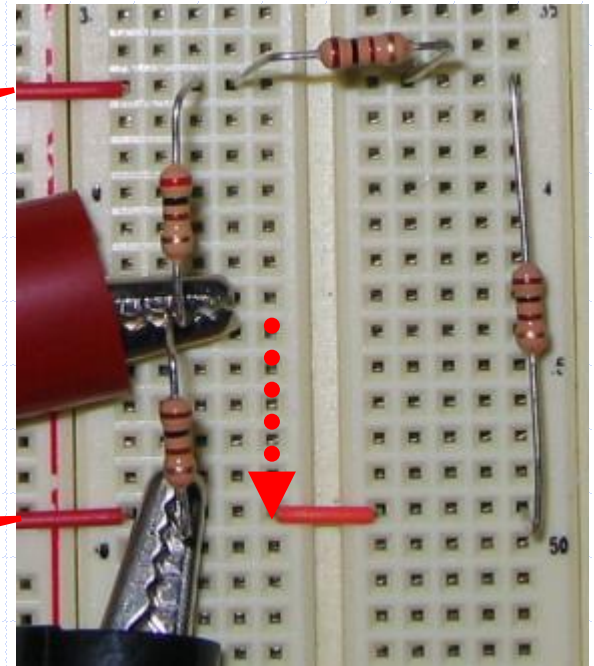


4-9D. 전압 측정

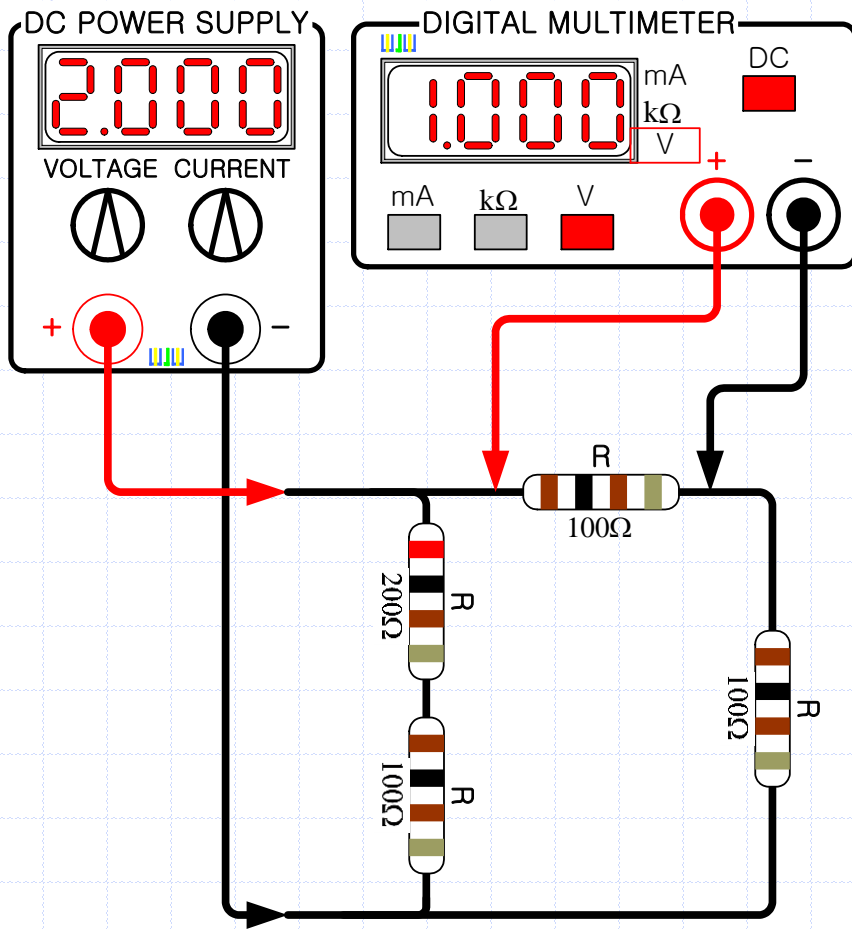


+2V

GND

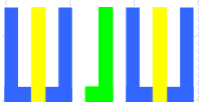
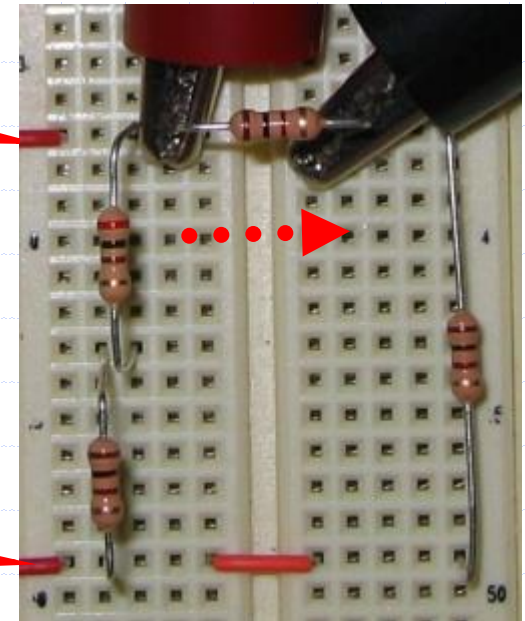


4-9D. 전압 측정

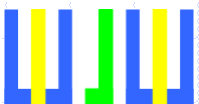
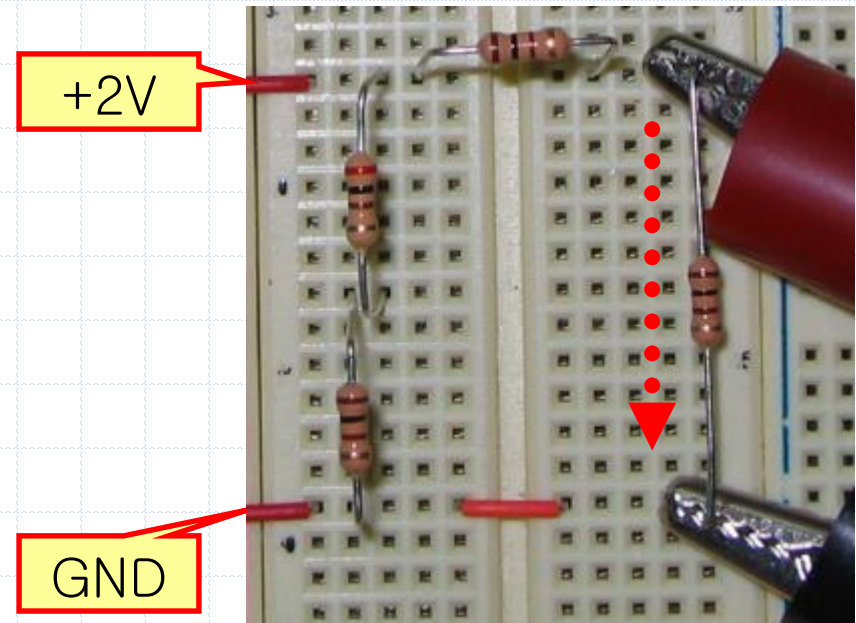
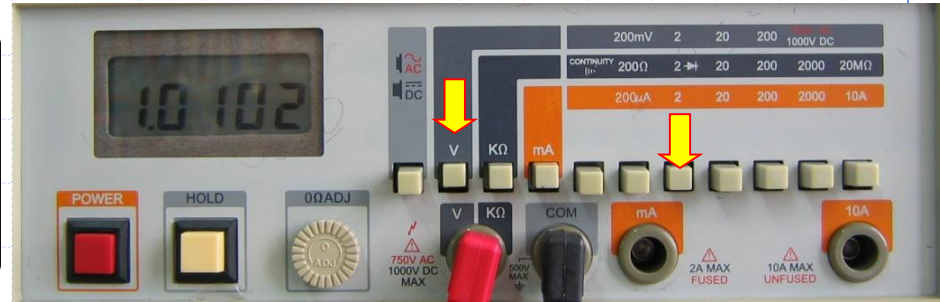
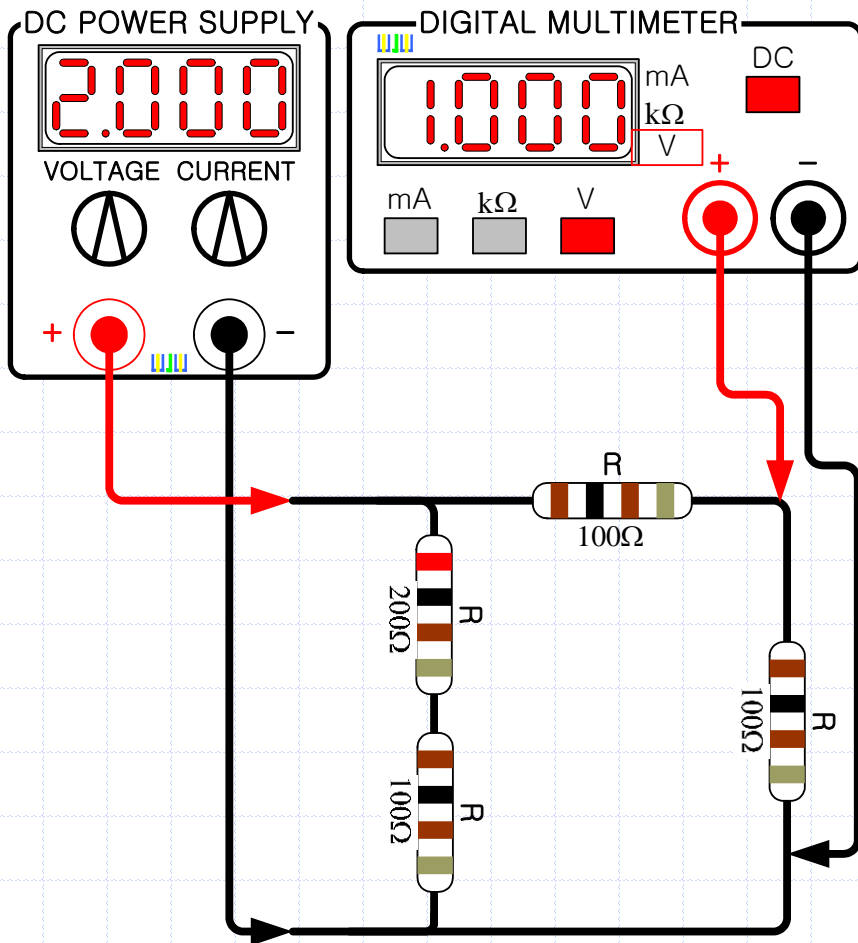


+2V

GND

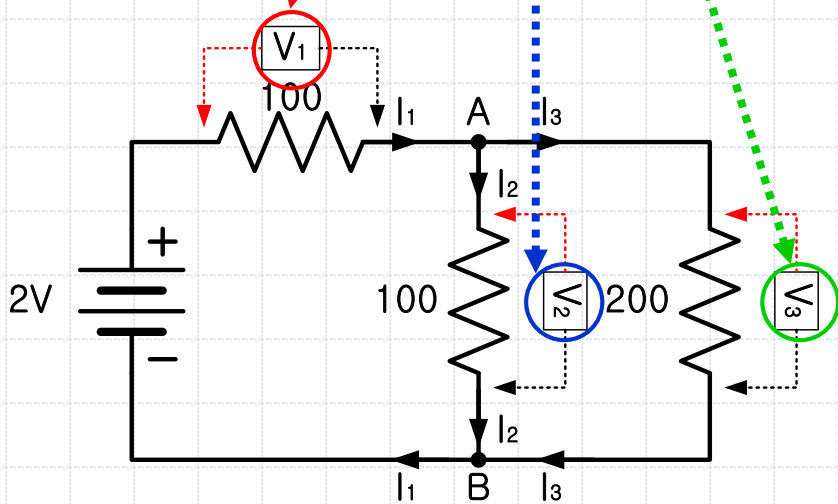
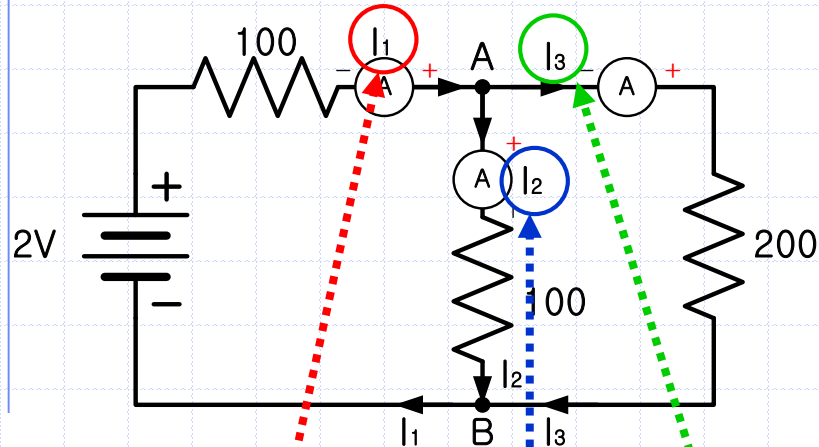


4-9D. 전압 측정



4-10A. 전력 계산

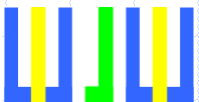
전력 계산



I_1	12 mA	V_1	1.2 V
P_1	$= I_1 \times V_1 = 14.4 \text{ mW}$		

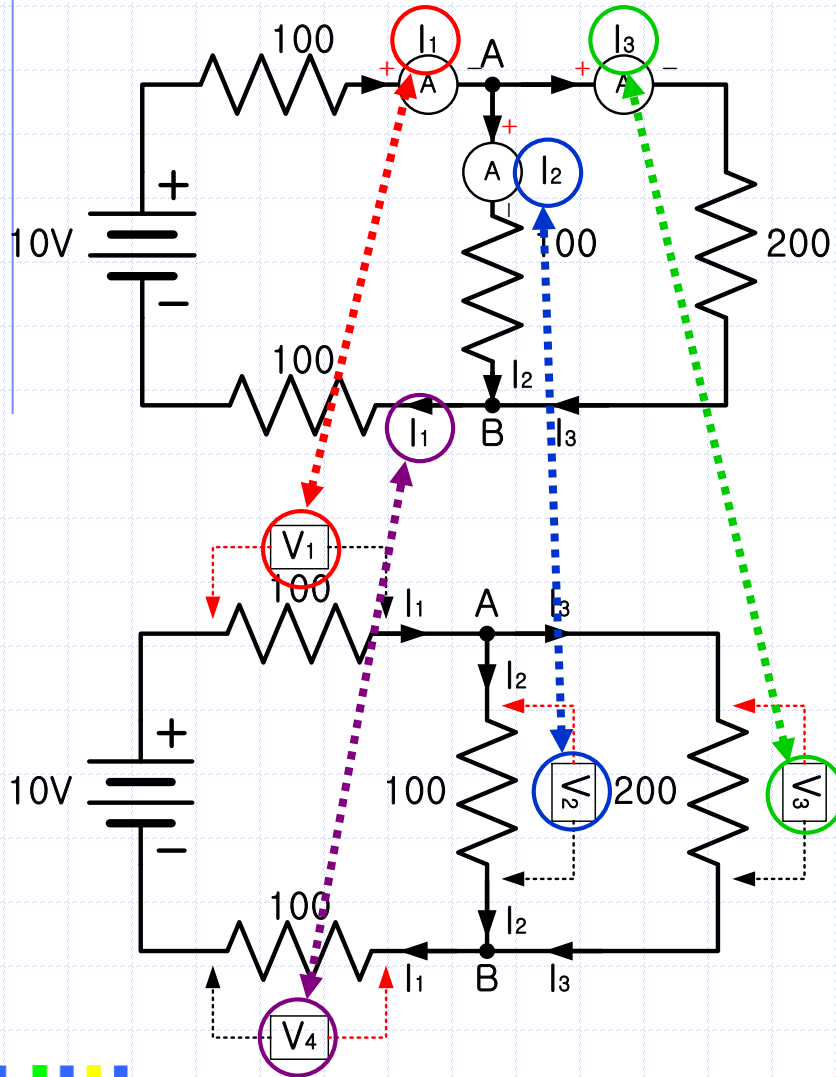
I_2	8 mA	V_2	0.8 V
P_2	$= I_2 \times V_2 = 6.4 \text{ mW}$		

I_3	4 mA	V_3	0.8 V
P_3	$= I_3 \times V_3 = 3.2 \text{ mW}$		



4-10B. 전력 계산

전력 계산

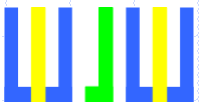


I_1	37.5 mA	V_1	3.75 V
P_1	$= I_1 \times V_1 = 140.625 \text{ mW}$		

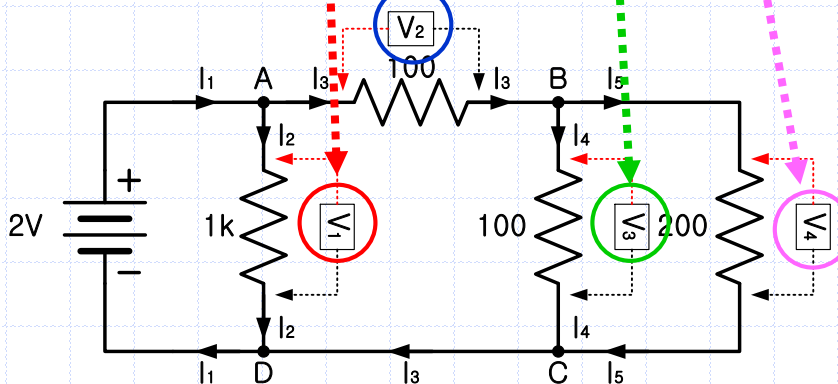
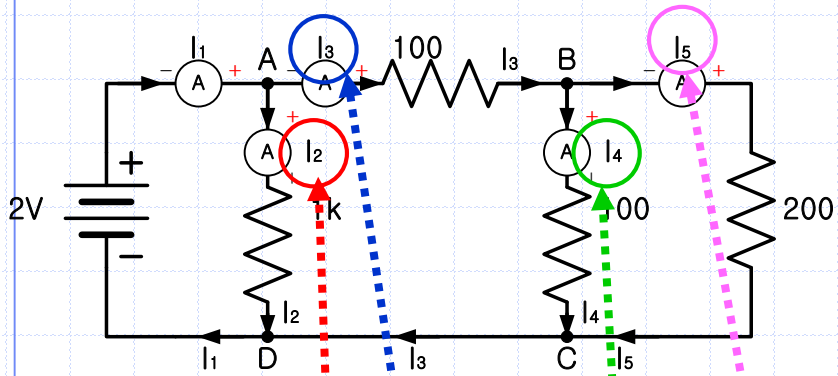
I_2	25 mA	V_2	2.5 V
P_2	$= I_2 \times V_2 = 62.5 \text{ mW}$		

I_3	12.5 mA	V_3	2.5 V
P_3	$= I_3 \times V_3 = 31.25 \text{ mW}$		

I_1	37.5 mA	V_4	3.75 V
P_4	$= I_1 \times V_4 = 140.625 \text{ mW}$		



4-10C. 전력 계산



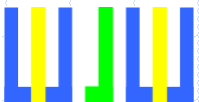
전력 계산

I_2	2 mA	V_1	2 V
P_1	$= I_2 \times V_1 = 4 \text{ mW}$		

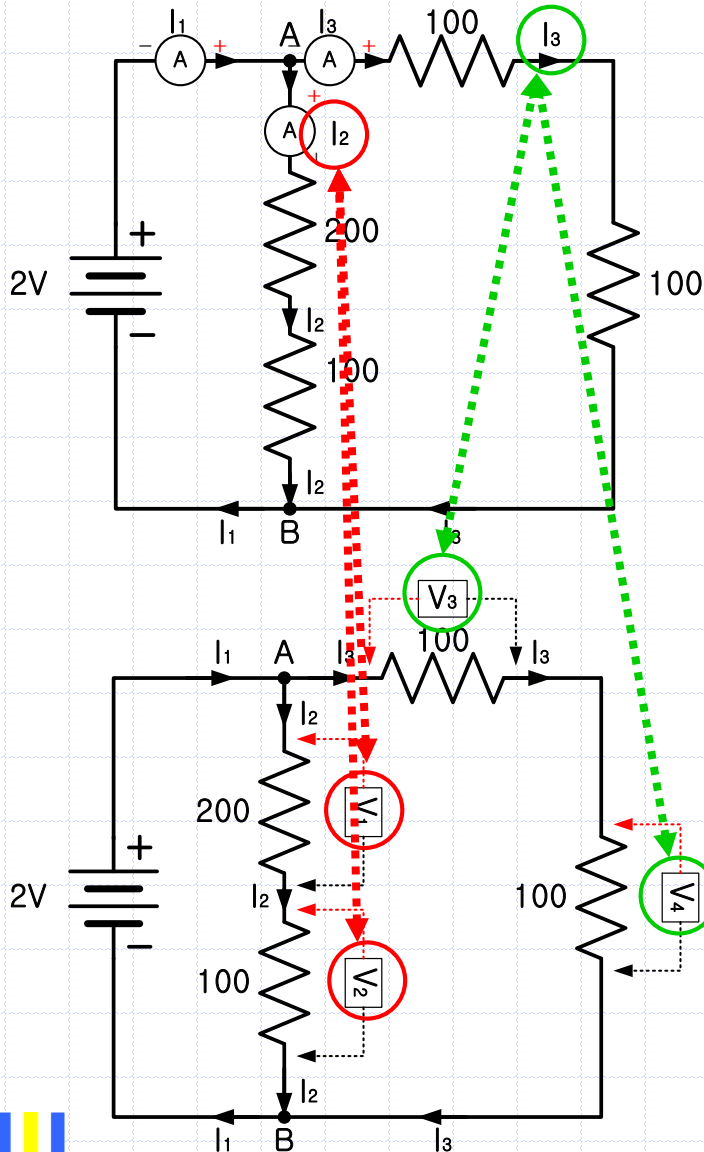
I_3	12 mA	V_2	1.2 V
P_2	$= I_3 \times V_2 = 14.4 \text{ mW}$		

I_4	8 mA	V_3	0.8 V
P_3	$= I_4 \times V_3 = 6.4 \text{ mW}$		

I_5	4 mA	V_4	0.8 V
P_4	$= I_5 \times V_4 = 3.2 \text{ mW}$		



4-10D. 전력 계산



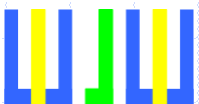
전력 계산

I_2	6.67 mA	V_1	1.334 V
P_1	$= I_2 \times V_1 = 8.898 \text{ mW}$		

I_2	6.67 mA	V_2	0.667 V
P_2	$= I_2 \times V_2 = 4.449 \text{ mW}$		

I_3	10 mA	V_3	1 V
P_3	$= I_3 \times V_3 = 10 \text{ mW}$		

I_3	10 mA	V_4	1 V
P_4	$= I_3 \times V_4 = 10 \text{ mW}$		



4-11. 직류 전원 공급 장치 (DC Power Supply)

✓ DC Power Supply 사용하기

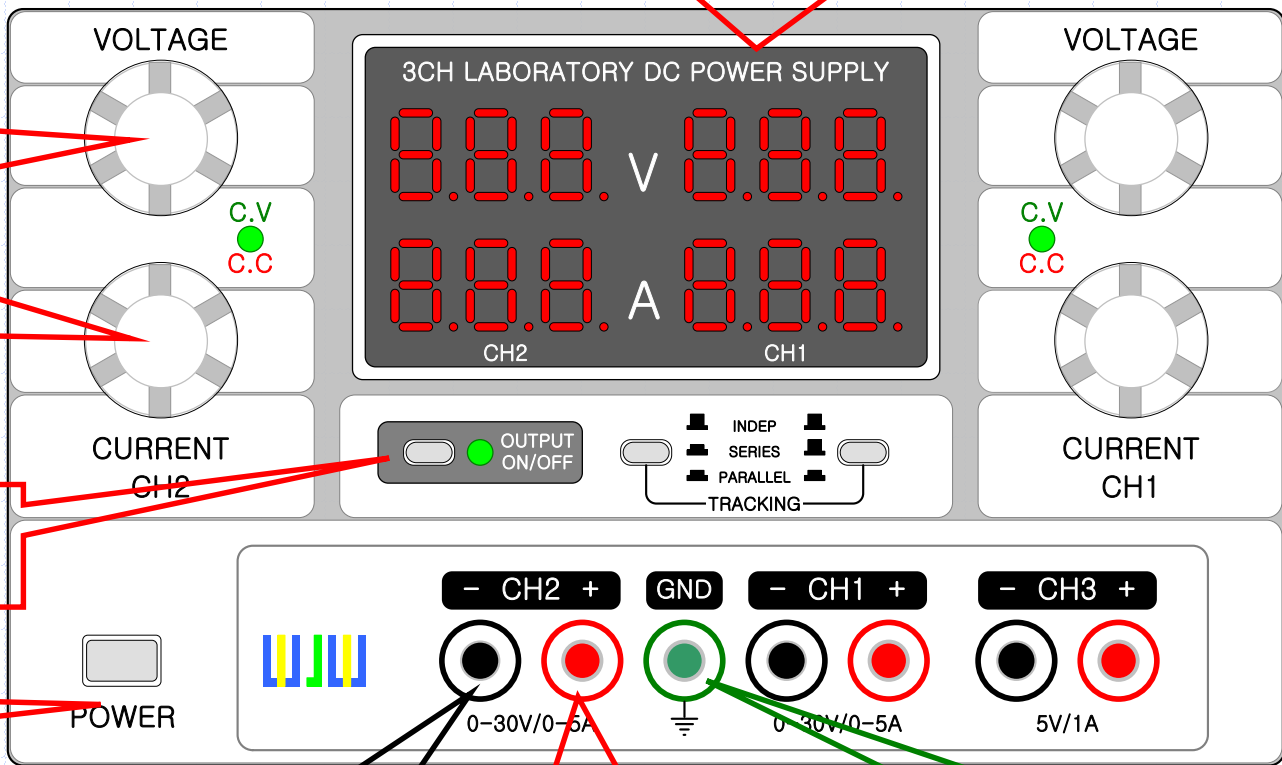
전압 및 전류 표시부

전압
조절
단자

전류
조절
단자

DC 출력
ON/OFF

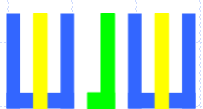
전원



- 단자 (검정)

+ 단자 (빨강)

GND 단자 (녹색)



4-11. 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

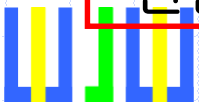
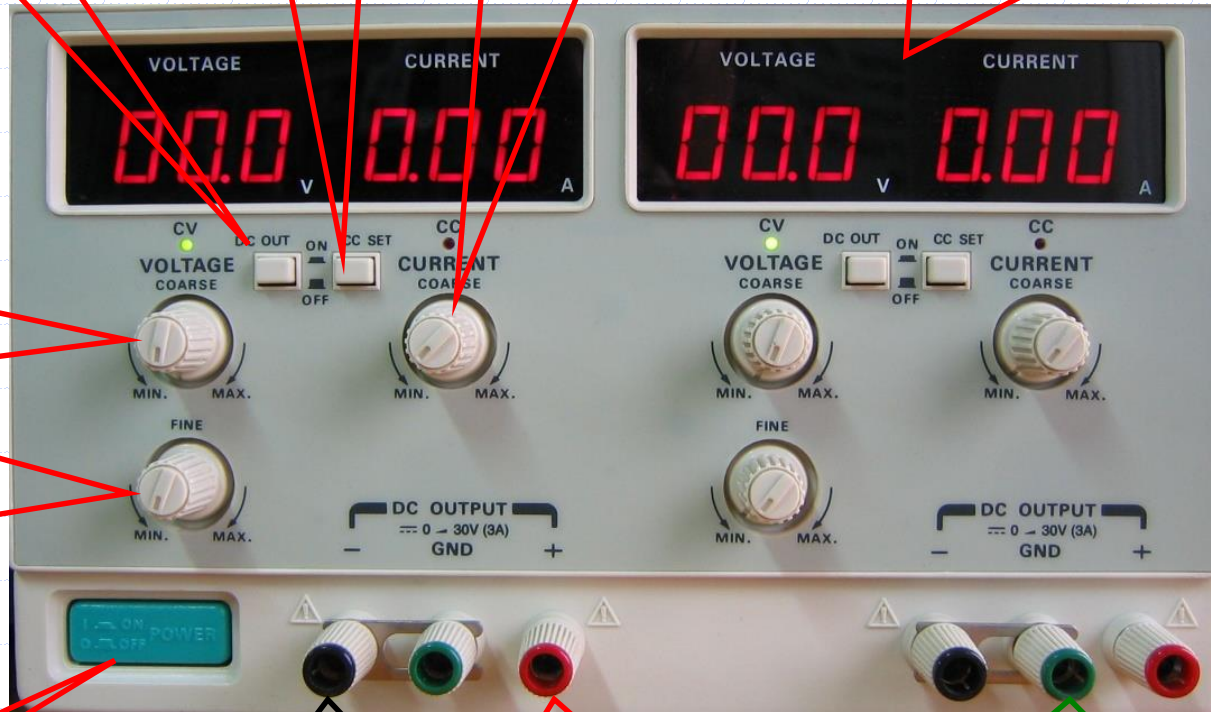
전압
미세
조절
단자

전원

- 단자 (검정)

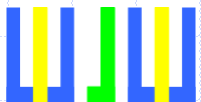
+ 단자 (빨강)

GND 단자 (녹색)



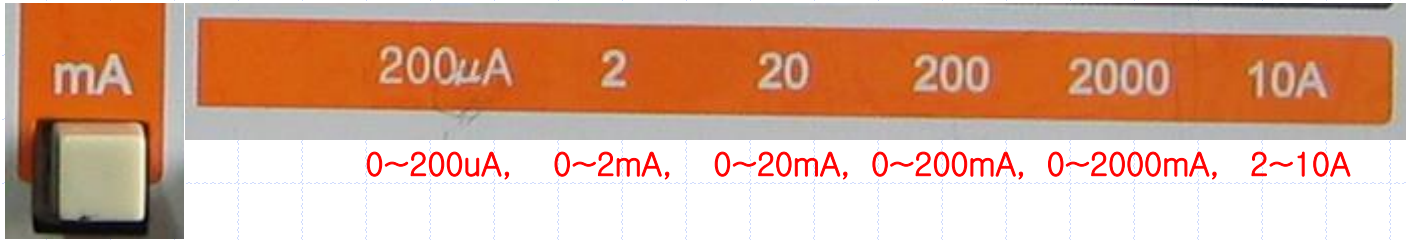
4-11. 직류 전원 공급 장치 (DC Power Supply)

- ✓ DC Power Supply 사용하기



4-12. 전류 측정 범위의 선택

✓ 전류 1.5mA를 여러 가지 측정 범위로 측정



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



측정 범위 : 0 ~ 2mA
측 정 값 : 1.5006mA
오차 : 0.04%



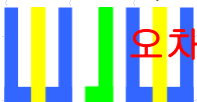
측정 범위 : 0 ~ 20mA
측 정 값 : 1.636mA
오차 : 9.07%



측정 범위 : 0 ~ 200mA
측 정 값 : 1.65mA
오차 : 10%

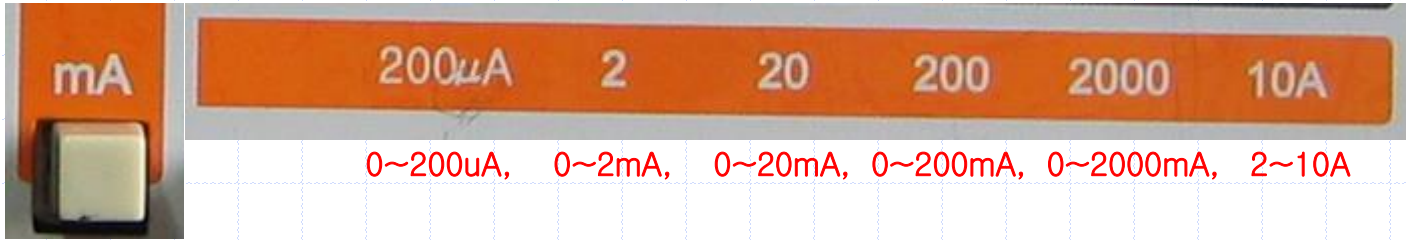


측정 범위 : 0 ~ 2000mA
측 정 값 : 1.6mA
오차 : 6.67%



4-12. 전류 측정 범위의 선택

✓ 전류 100uA를 여러 가지 측정 범위로 측정



측정 범위 : 0 ~ 200uA
측 정 값 : 100.14uA
오차 : 0.14%



측정 범위 : 0 ~ 2mA
측 정 값 : 0.1082mA
오차 : 8.2%



측정 범위 : 0 ~ 20mA
측 정 값 : 0.108mA
오차 : 8%



측정 범위 : 0 ~ 200mA
측 정 값 : 0.11mA
오차 : 10%



측정 범위 : 0 ~ 2000mA
측 정 값 : 0 ⇔ 0.1mA
오차 : 측정값이 불분명함.

