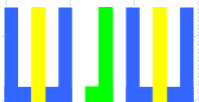


회로 이론/실습

6. 테브넨의 정리



6. 테브년의 정리

6-1. 목적 및 배경

6-2. 소요 부품 및 장비

6-3. 유용한 공식

테브년과 노턴의 정리

6-4. 임의의 회로 부하단 측정

6-5. 테브년의 정리

등가 전압원 측정

6-6. 테브년의 정리

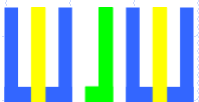
등가 저항 측정

6-7. 테브년의 등가 회로

6-8. 테브년 등가를 이용한 측정

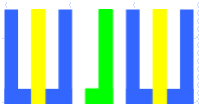
6-9. 테브년 등가를 이용한 측정 비교

6-10. 테브년과 노턴의 등가 회로 예제



6-1. 목적 및 배경

- ✓ 전원을 포함하고 있는 임의의 회로를 테브넨의 정리를 이용하여 간략화하고, 실험을 통하여 확인한다.
- ✓ 전원을 포함하고 있는 임의의 회로를 노튼의 정리를 이용하여 간략화하고, 실험을 통하여 확인한다.
- ✓ 테브넨의 정리와 노튼의 정리의 상호 관계를 확인한다.



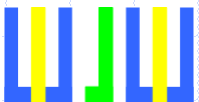
6-2. 소요 부품 및 장비

✓ 부품

- ✓ 저항 (1/4W) : 50Ω, 100Ω, 150Ω, 1kΩ

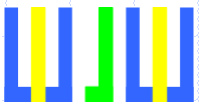
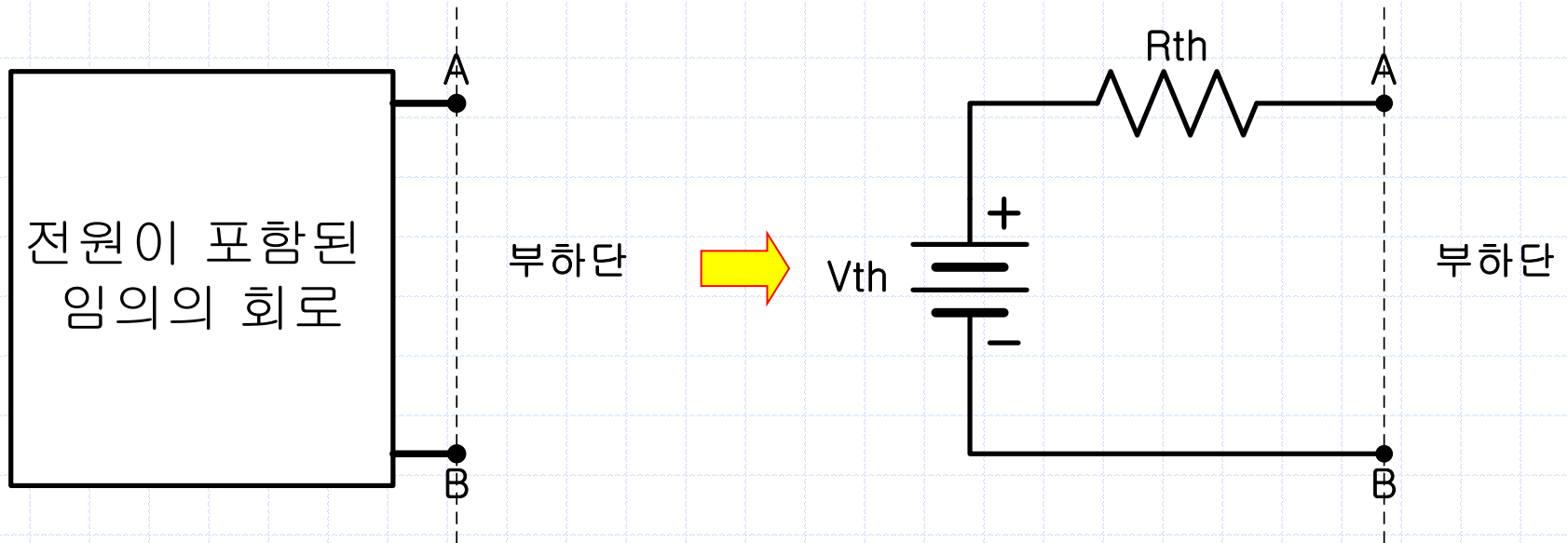
✓ 장비

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



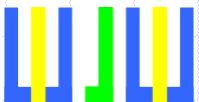
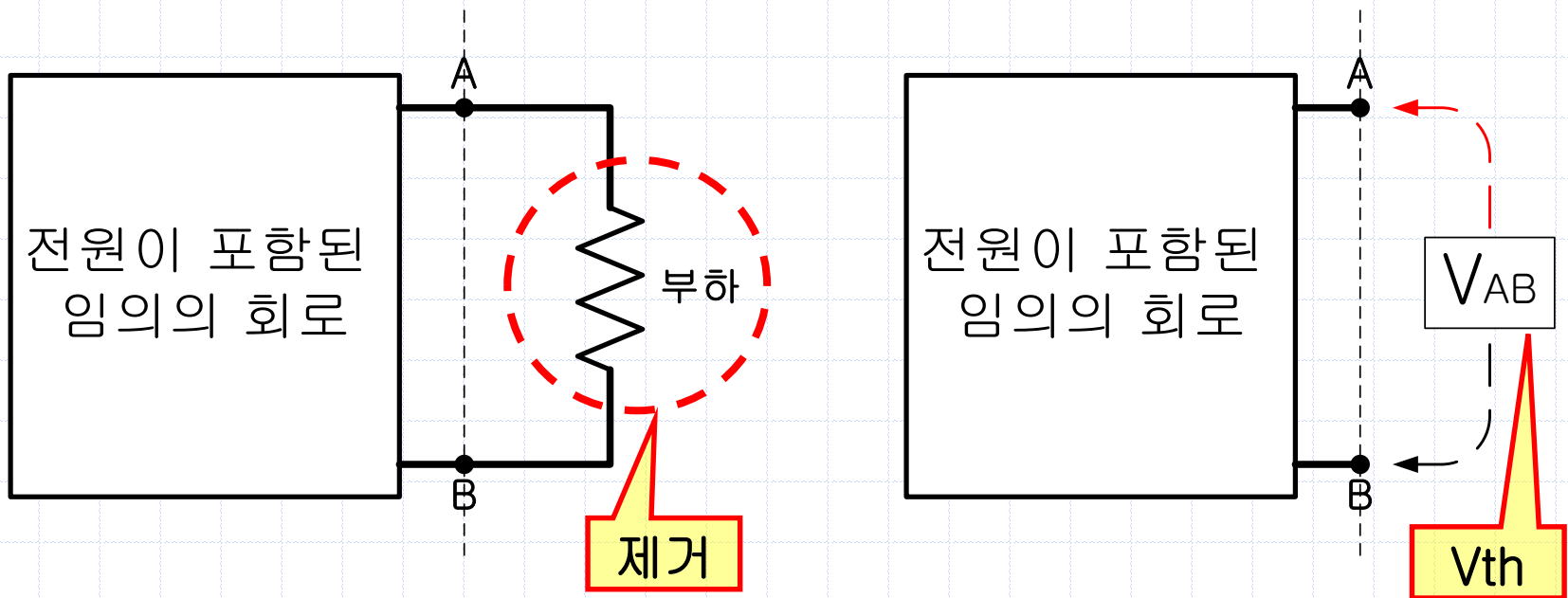
6-3A. 유용한 공식-테브넨의 정리

- ✓ 테브넨의 등가 회로 : 임의의 회로를 하나의 등가 전압원과 직렬로 연결된 하나의 등가 저항으로 간략화하여 표현한다.



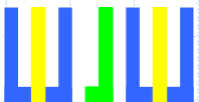
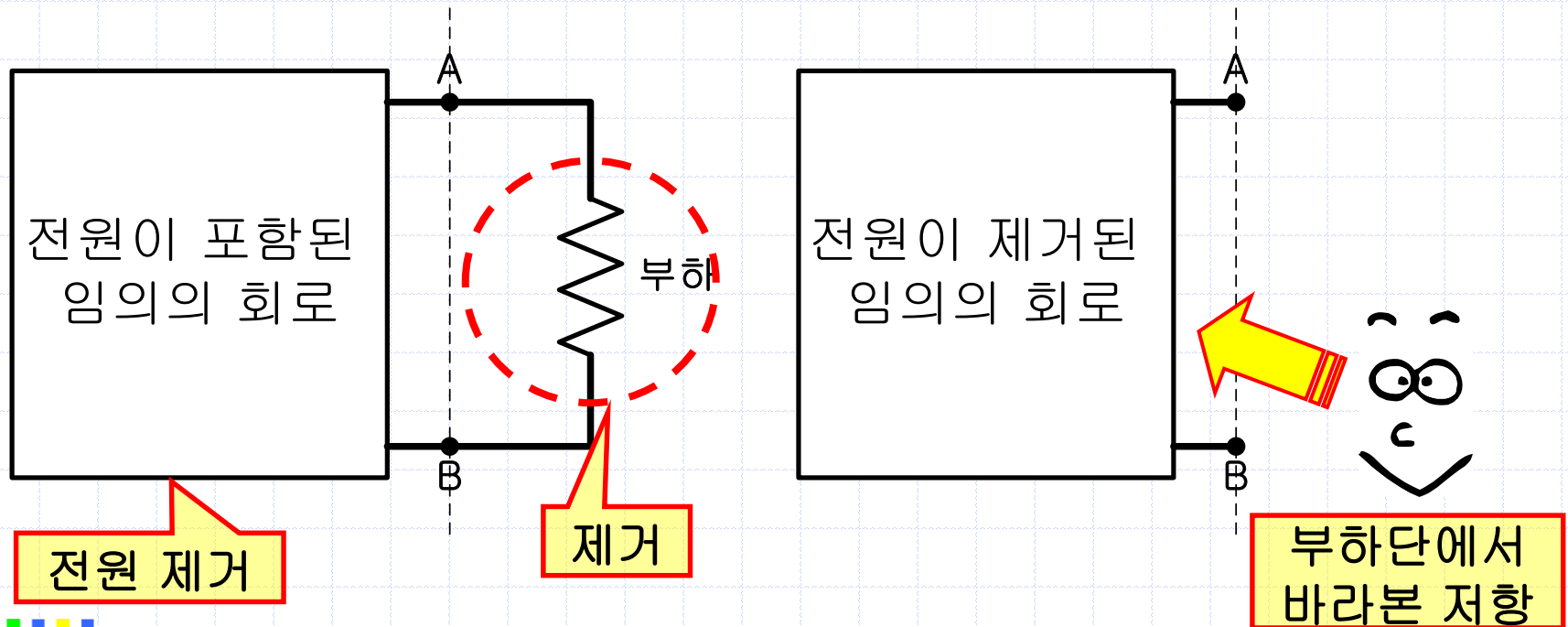
6-3A. 유용한 공식-테브넨의 정리

- ✓ 테브넨의 등가 전압원 (V_{th}) : 임의의 회로에서 부하를 제거하고 A-B점 양단의 전압



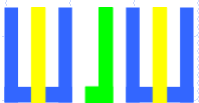
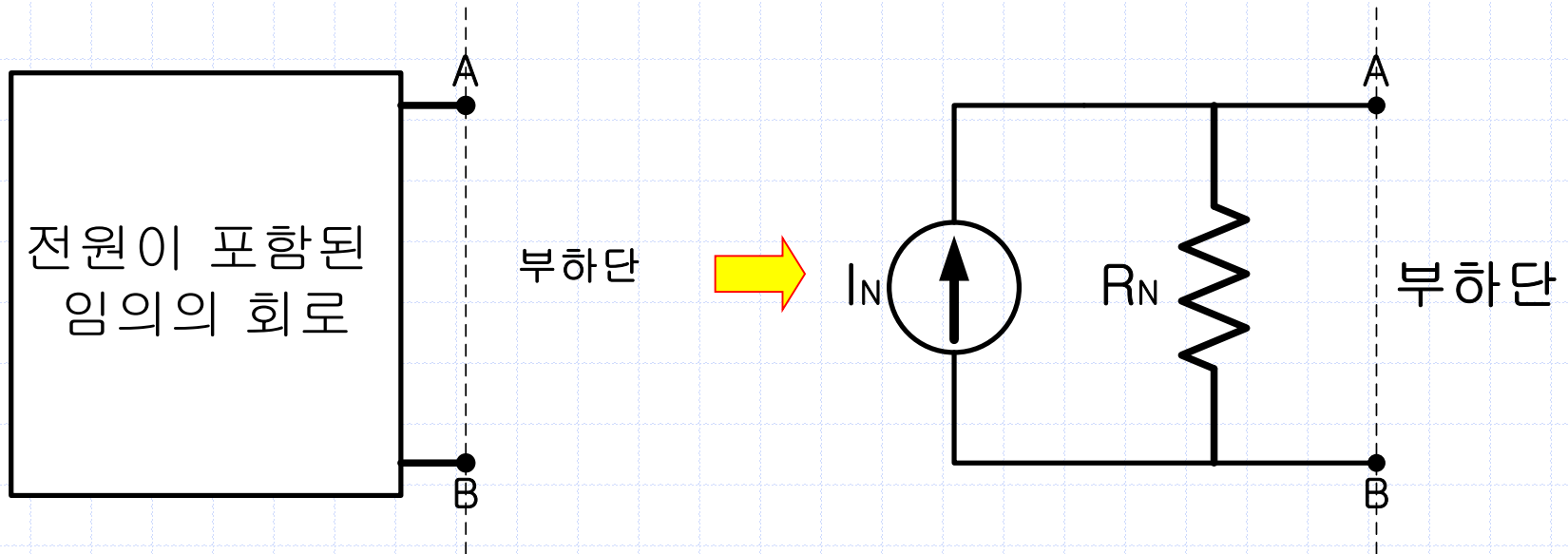
6-3A. 유용한 공식-테브넨의 정리

- ✓ 테브넨의 등가 저항 (R_{th}) : 임의의 회로에서 전원 및 부하를 제거하고 부하단에서 바라본 저항
- ✓ 전원 제거 방법 : 전압원 (단락), 전류원 (개방)



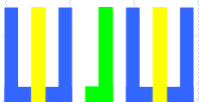
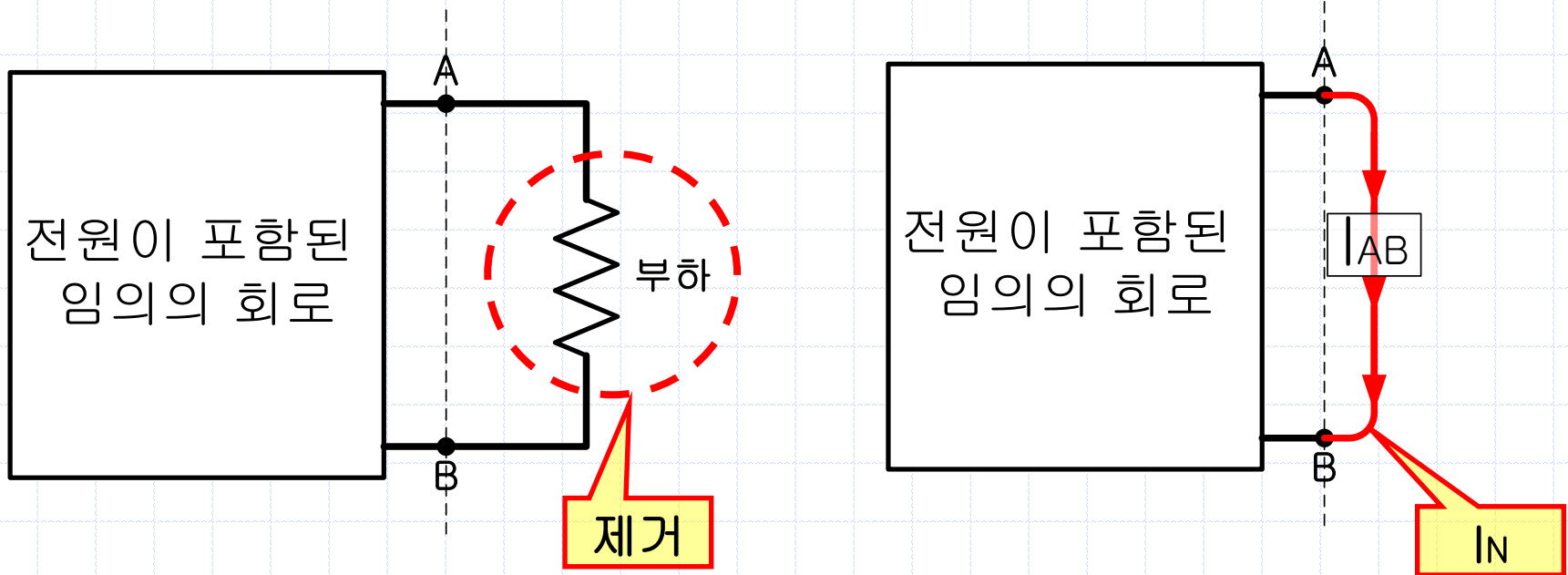
6-3B. 유용한 공식-노턴의 정리

- ✓ 노턴의 등가 회로 : 임의의 회로를 하나의 등가 전류원과 병렬로 연결된 하나의 등가 저항으로 간략화하여 표현한다.



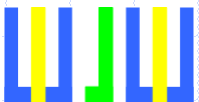
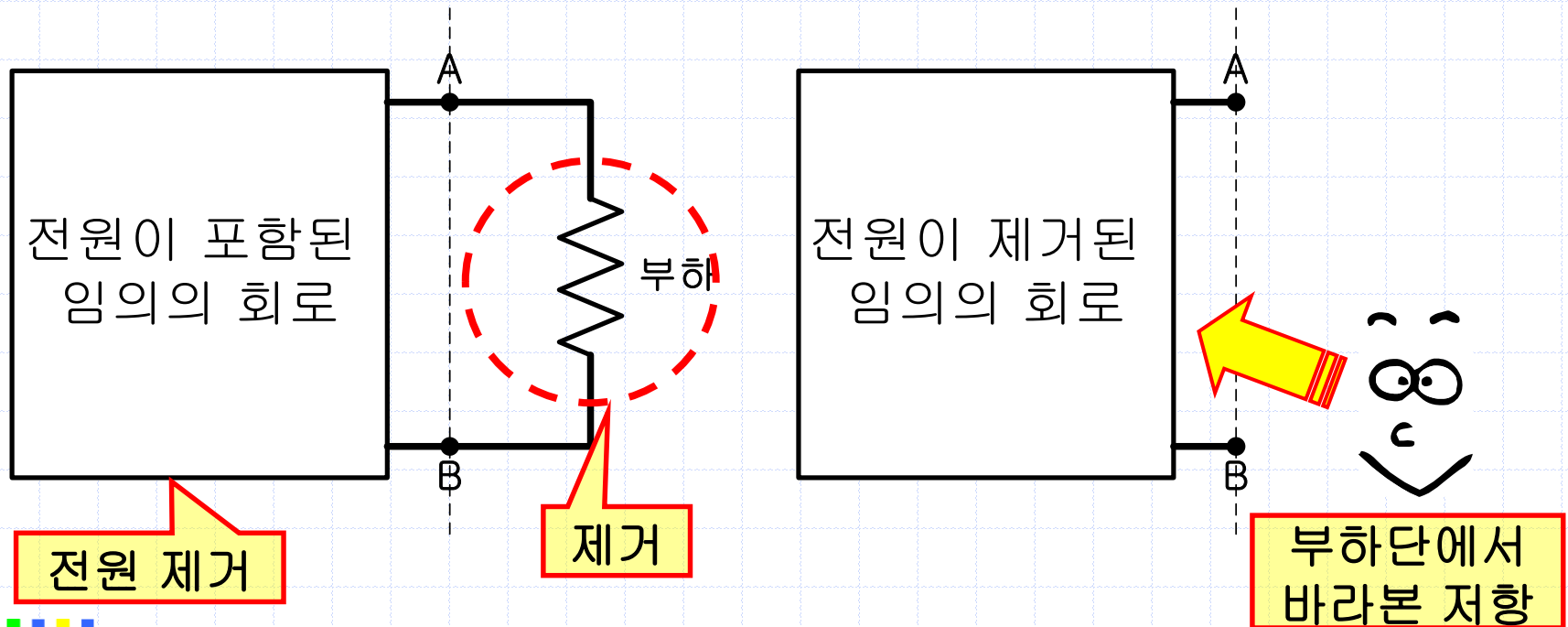
6-3B. 유용한 공식-노턴의 정리

- ✓ 노턴의 등가 전류원 (I_N) : 임의의 회로에서 부하를 제거하고 A-B점에 흐르는 전류

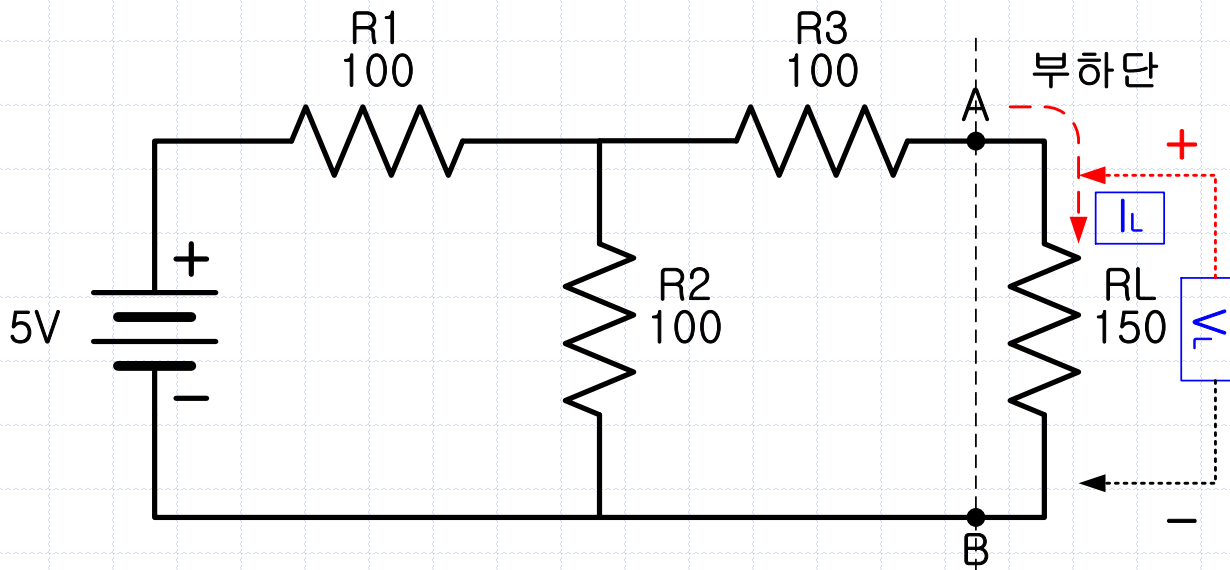


6-3B. 유용한 공식-노턴의 정리

- ✓ 노턴의 등가 저항 (R_N) : 임의의 회로에서 전원 및 부하를 제거하고 부하단에서 바라본 저항
- ✓ 전원 제거 방법 : 전압원 (단락), 전류원 (개방)

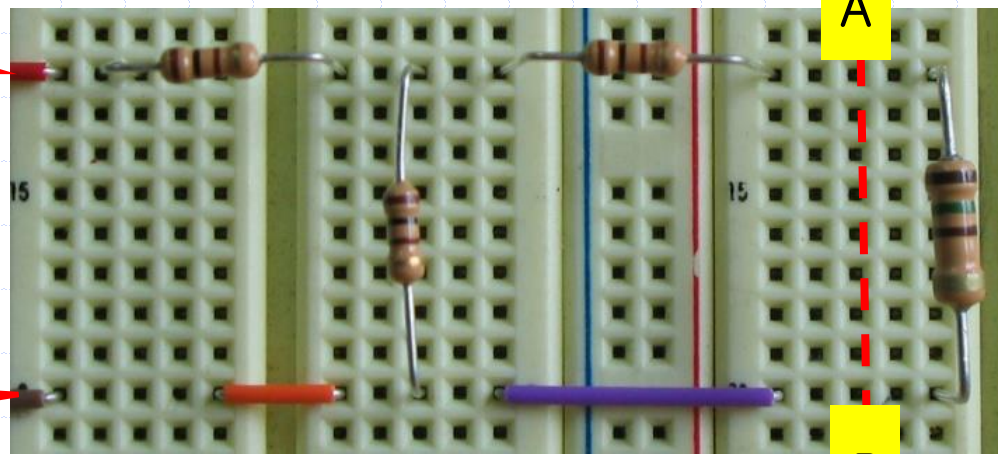


6-4A. 임의의 회로 부하단 측정



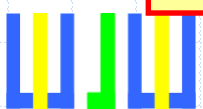
+5V

GND

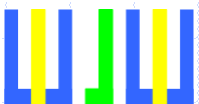
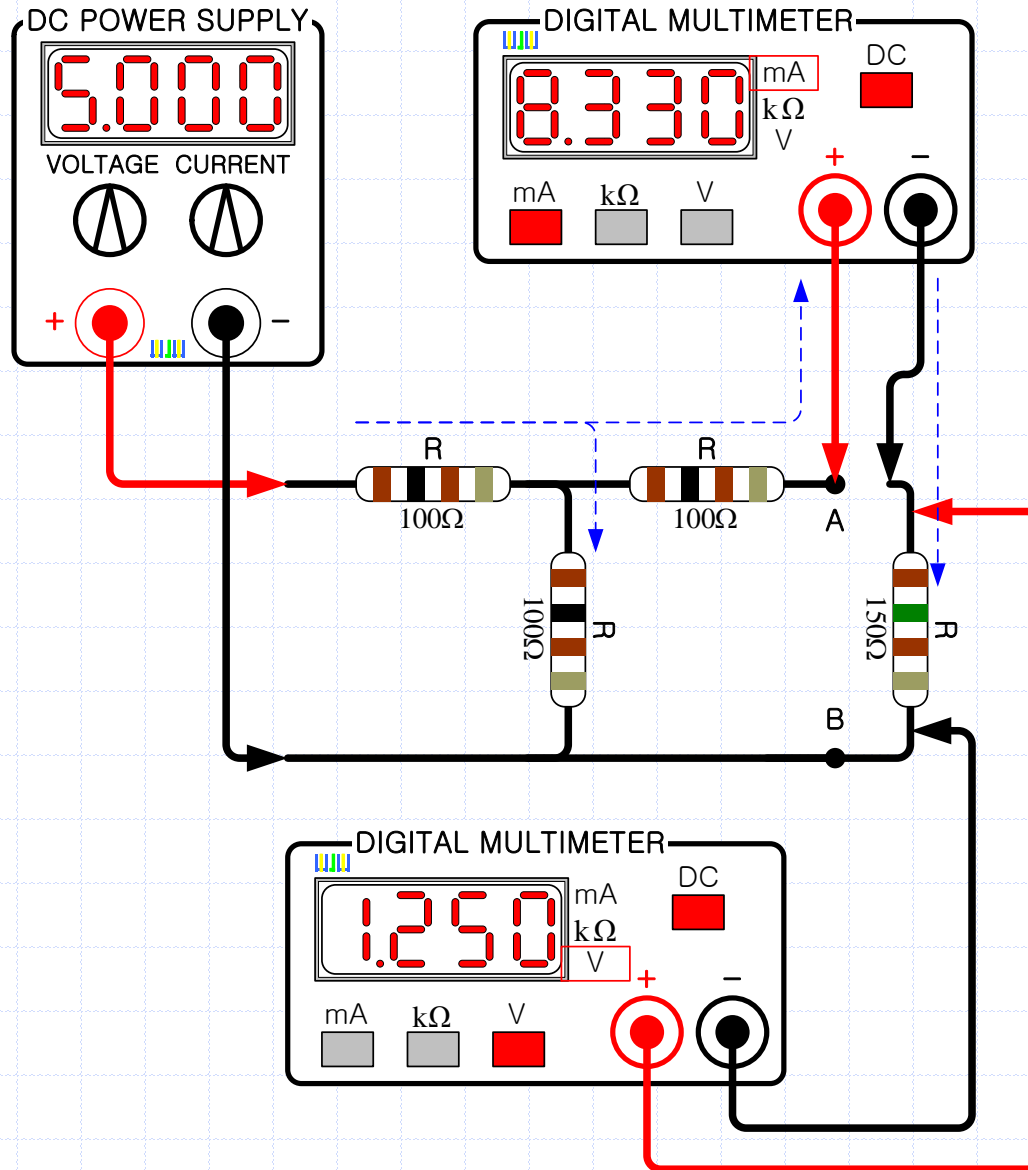


A

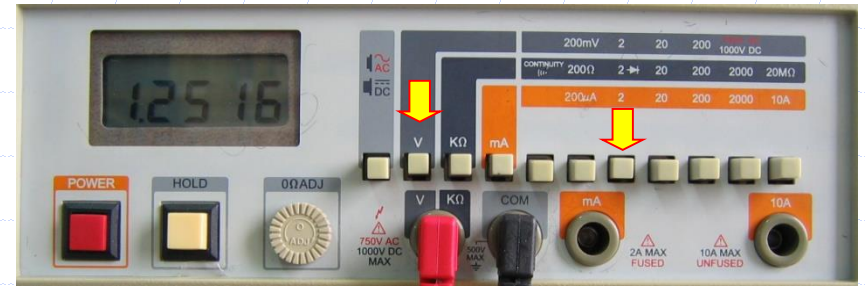
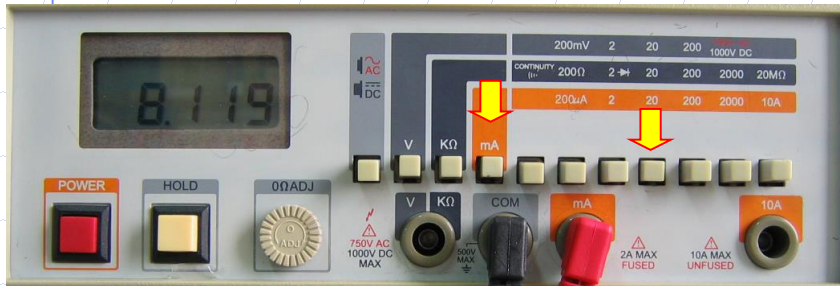
B



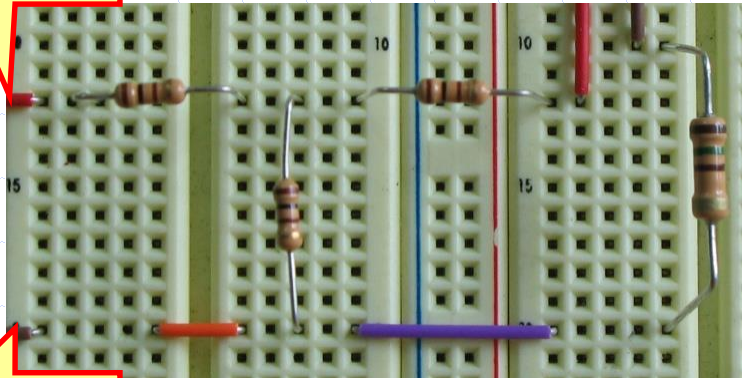
6-4A. 임의의 회로 부하단 측정



6-4A. 임의의 회로 부하단 측정

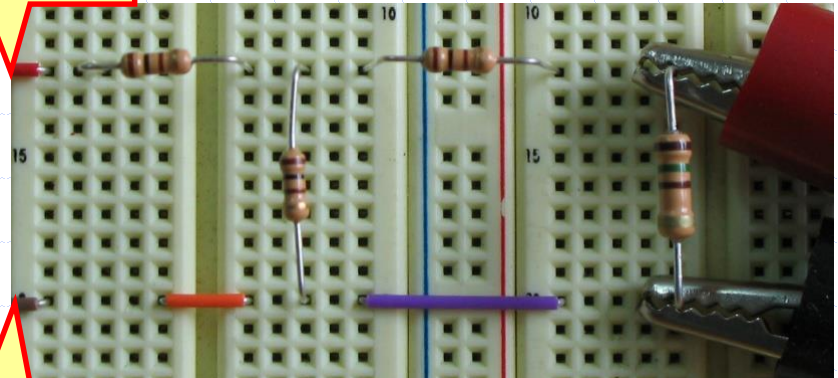


+5V

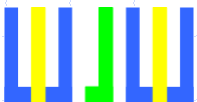


GND

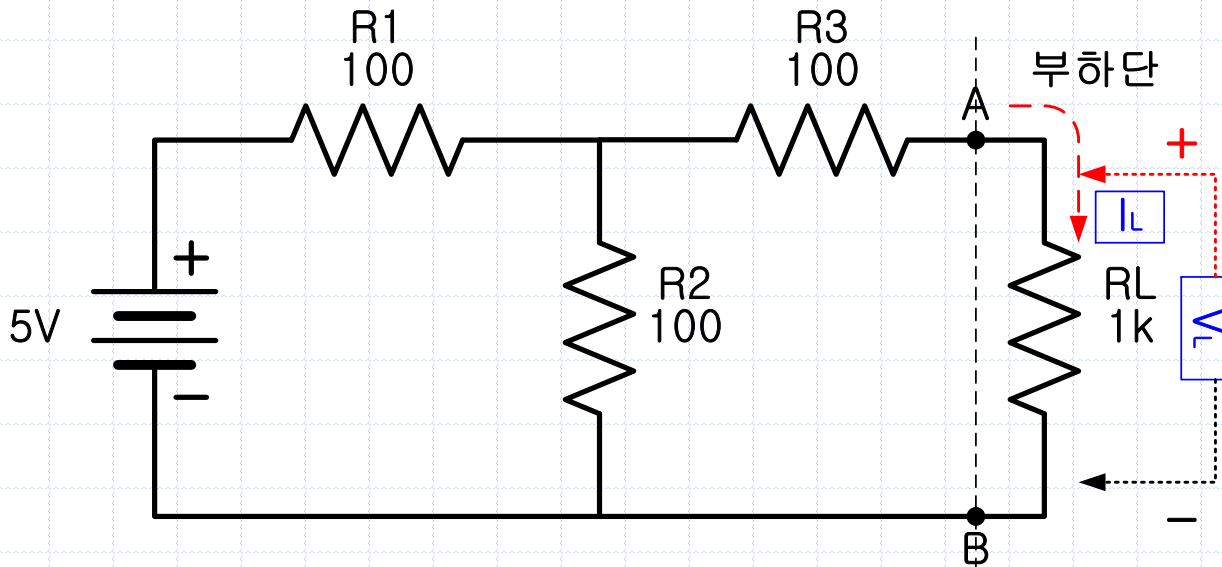
+5V



GND

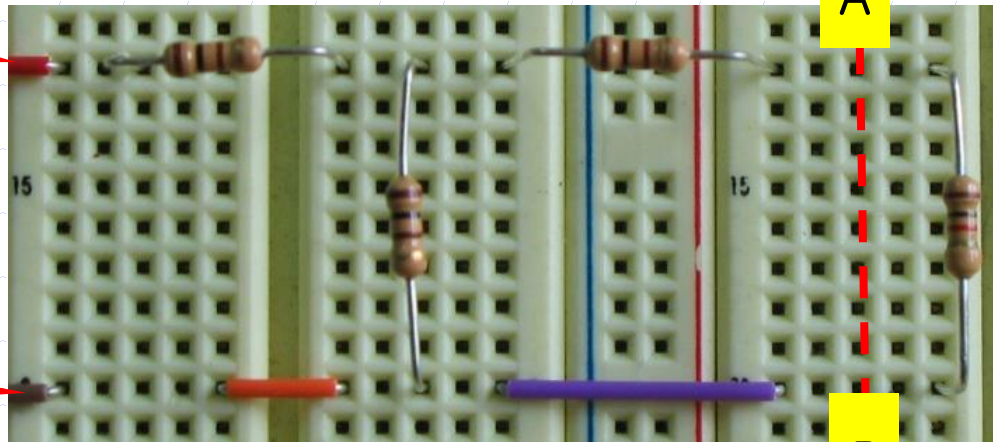


6-4B. 임의의 회로 부하단 측정



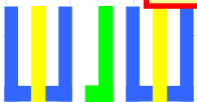
+5V

GND

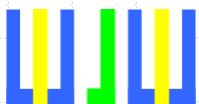
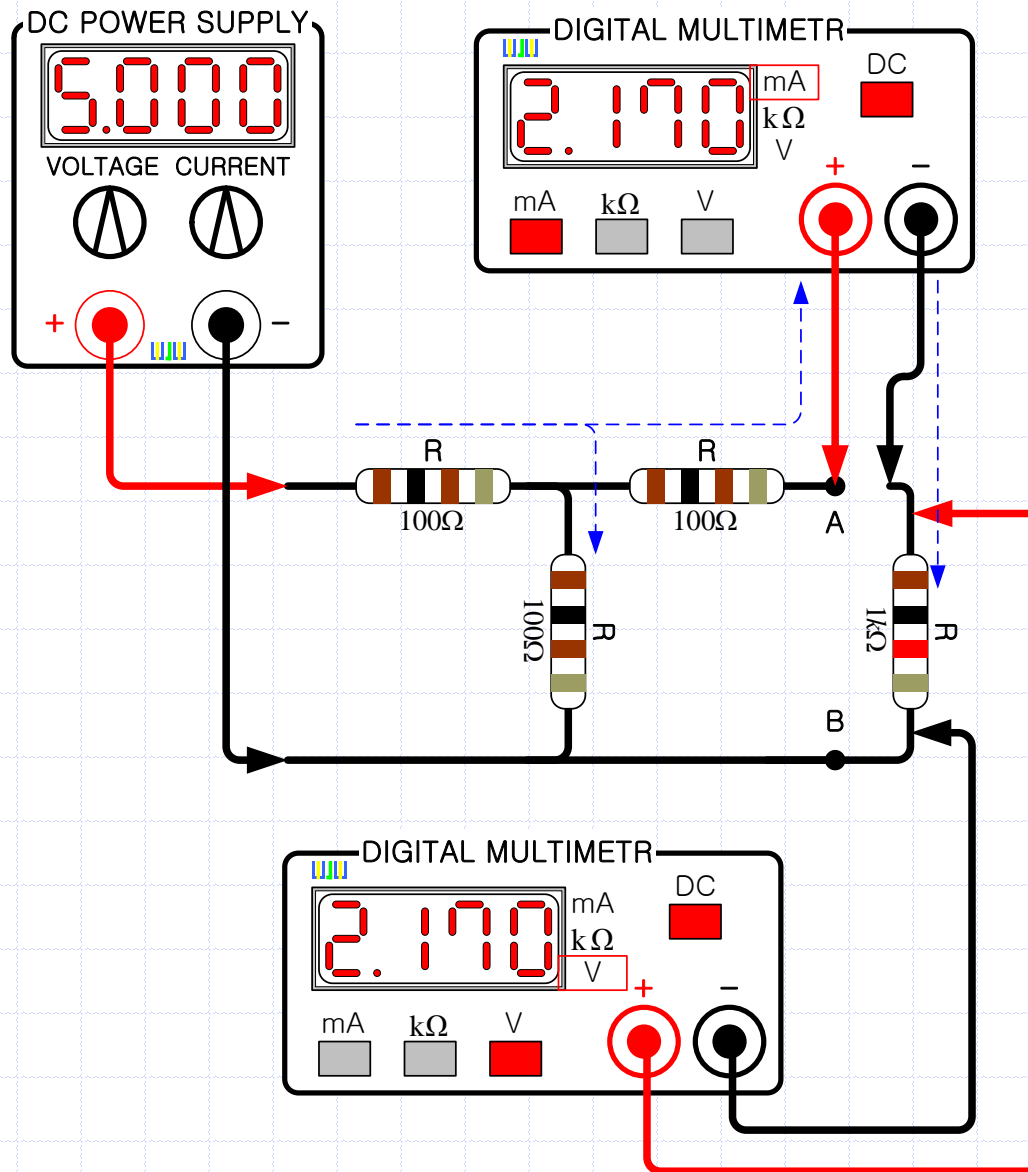


A

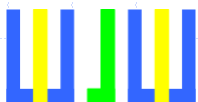
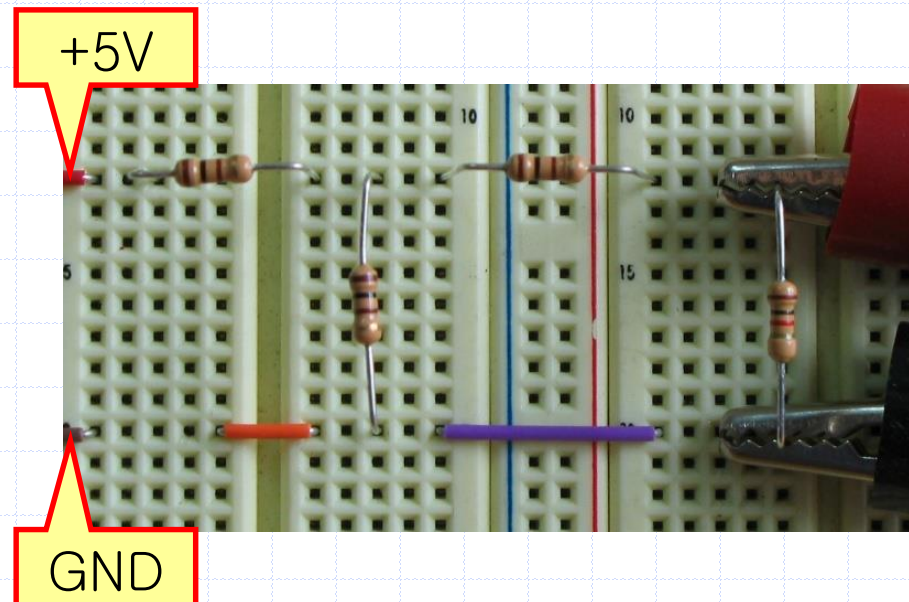
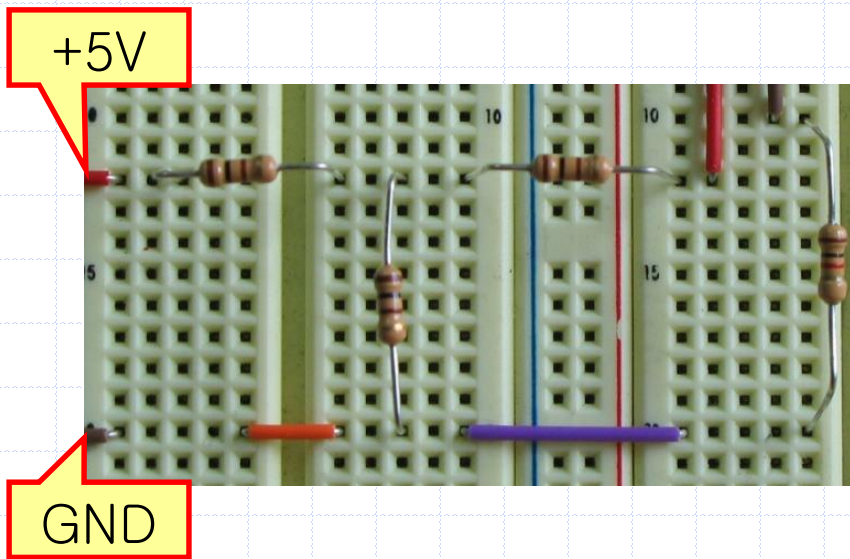
B



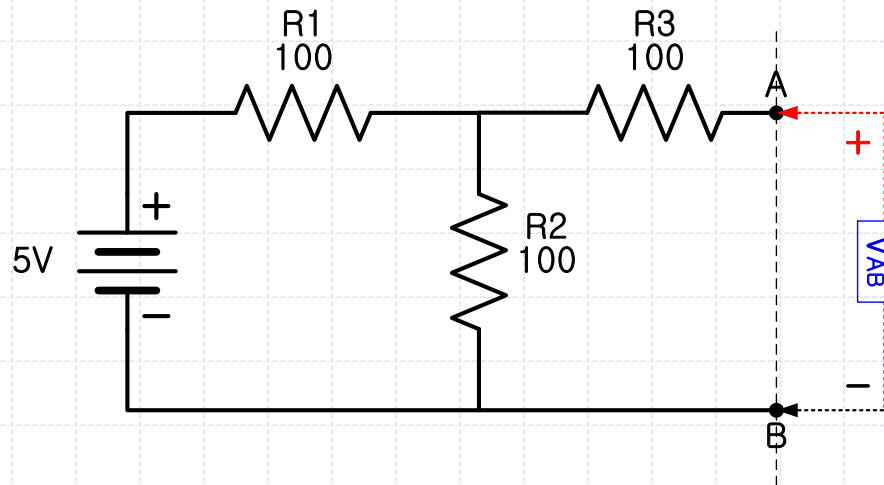
6-4B. 임의의 회로 부하단 측정



6-4B. 임의의 회로 부하단 측정



6-5. 테브넨의 정리-등가 전압원 측정



+5V

A

+5V

A

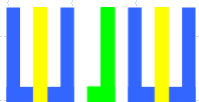
GND

B

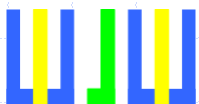
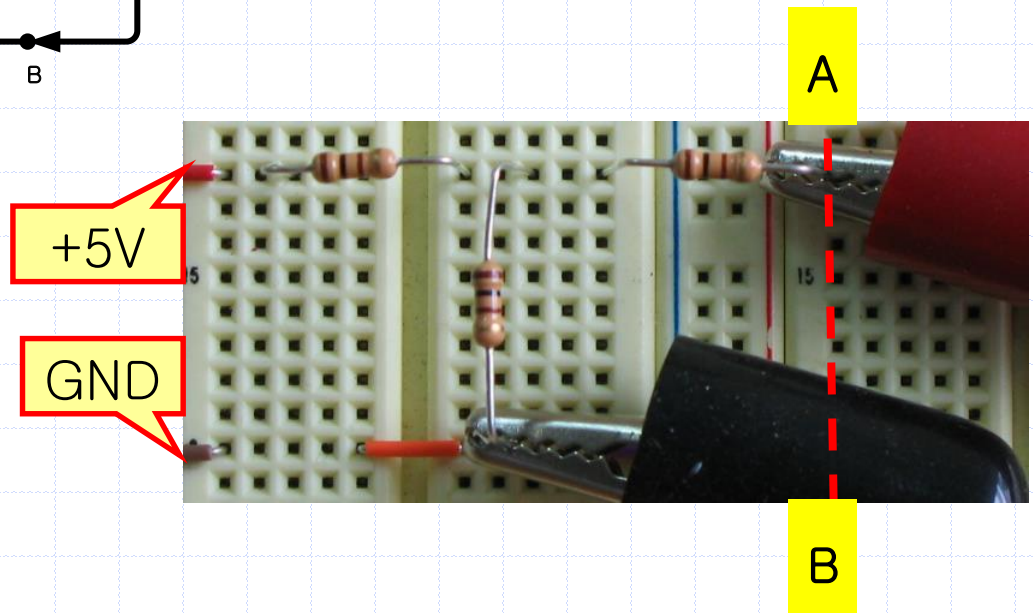
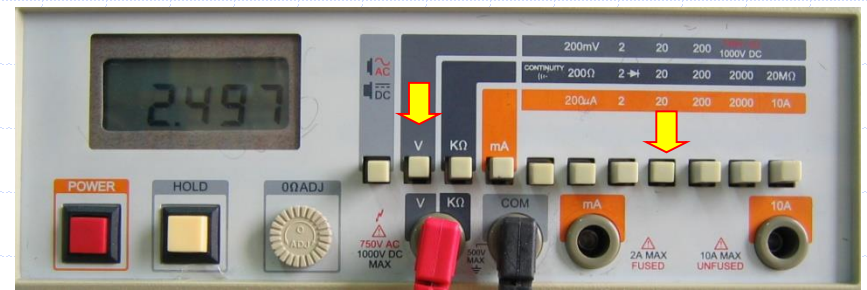
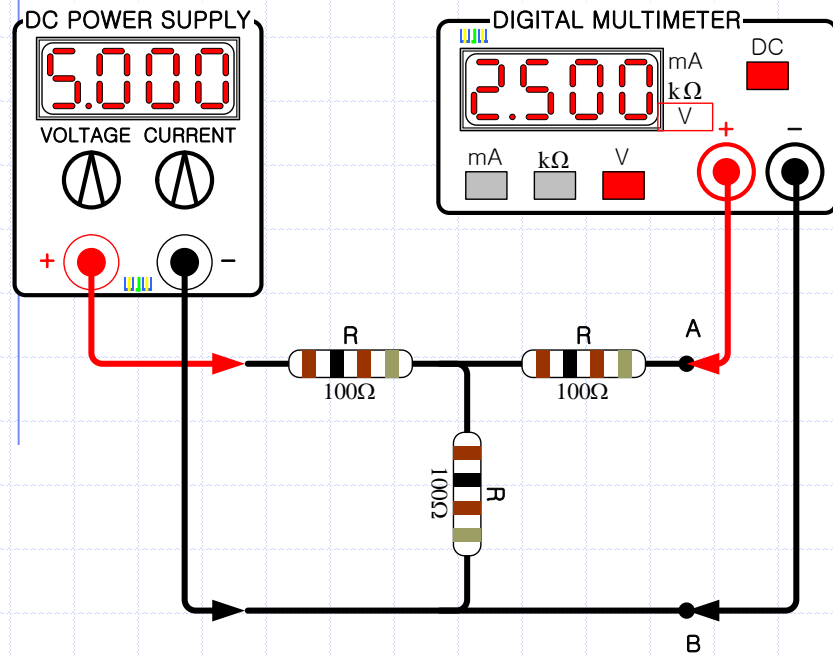
GND

B

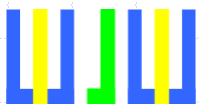
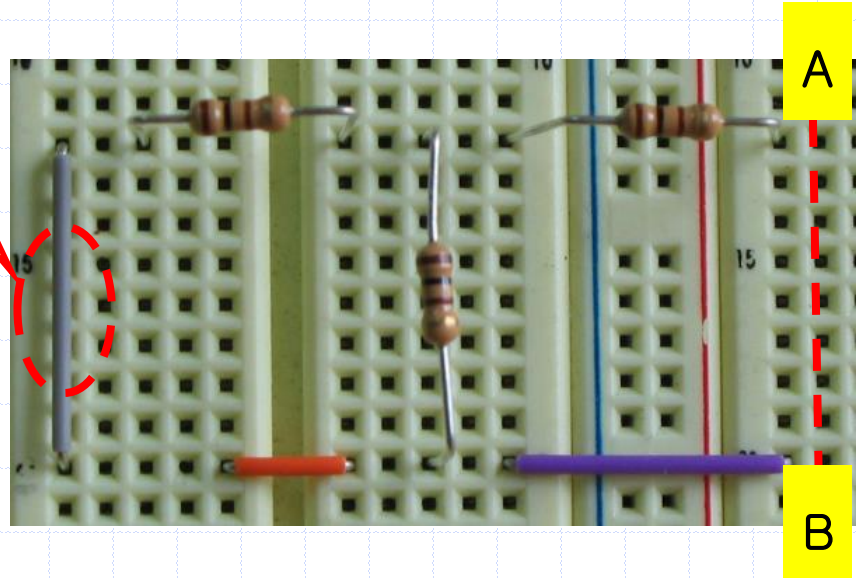
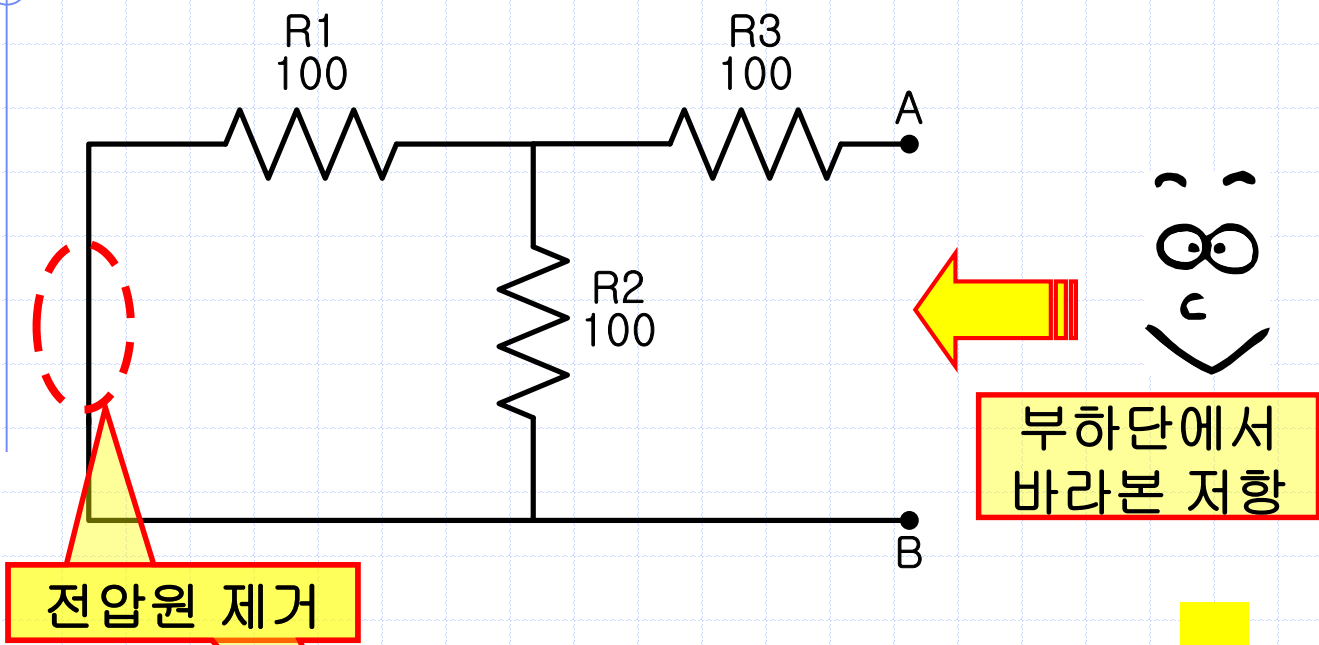
제거



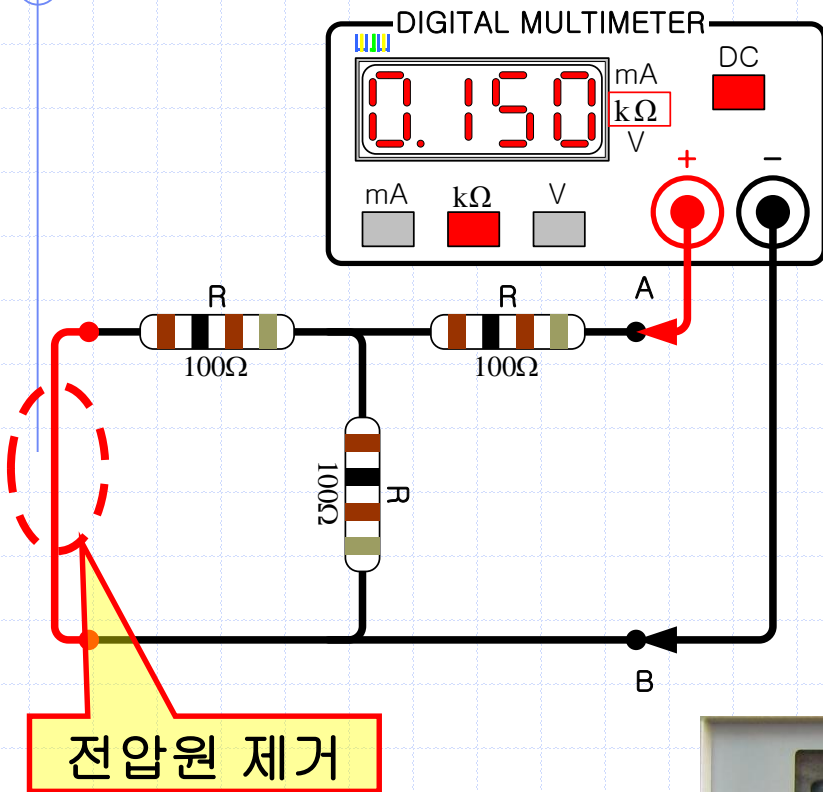
6-5. 테브넨의 정리-등가 전압원 측정



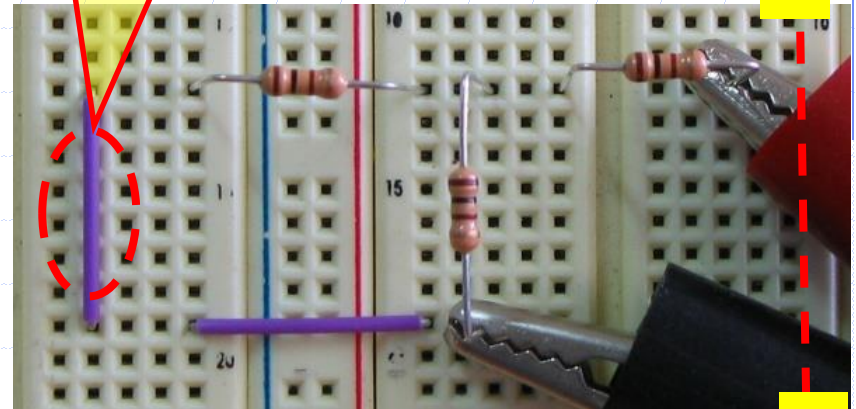
6-6. 테브넨의 정리-등가 저항 측정



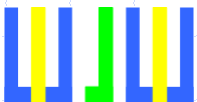
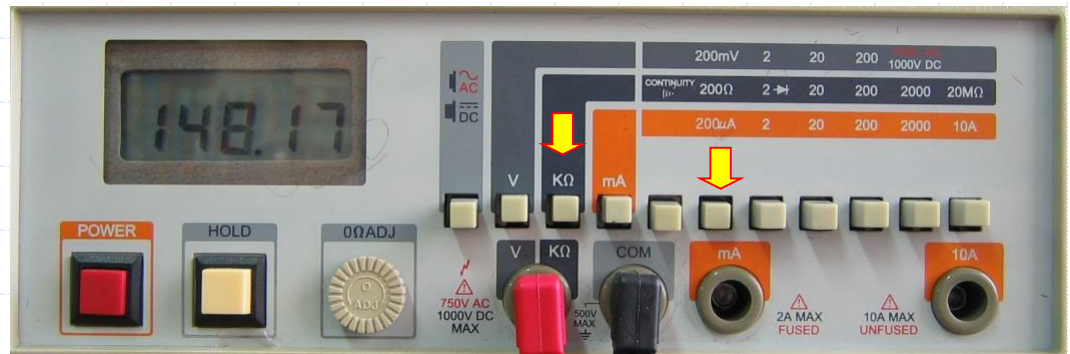
6-6. 테브넨의 정리-등가 저항 측정



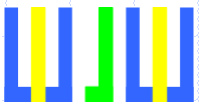
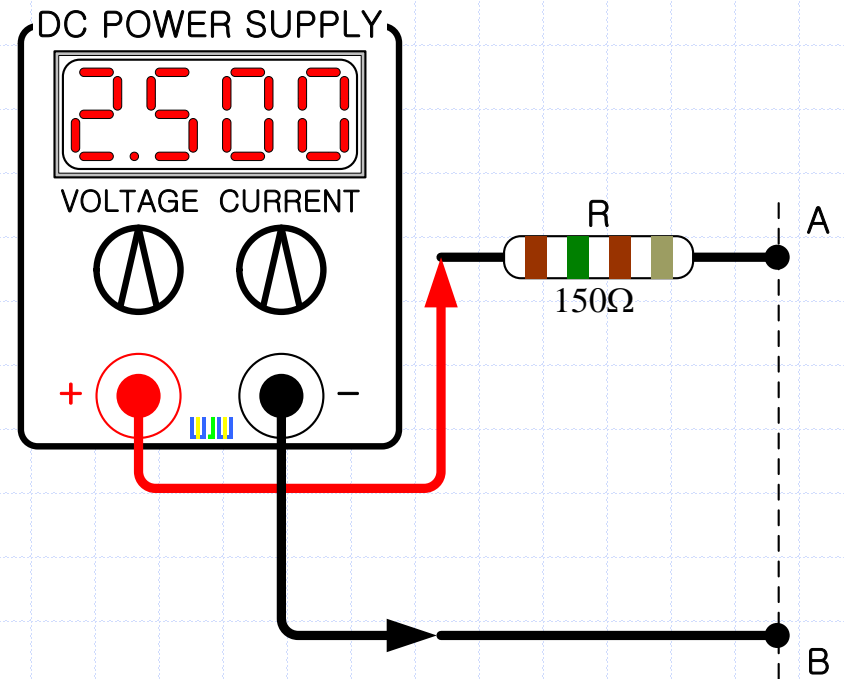
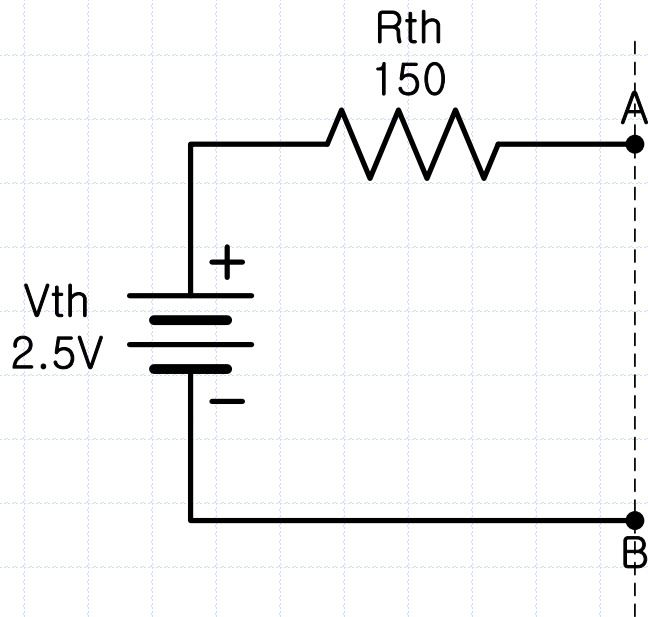
전압원 제거



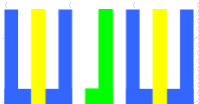
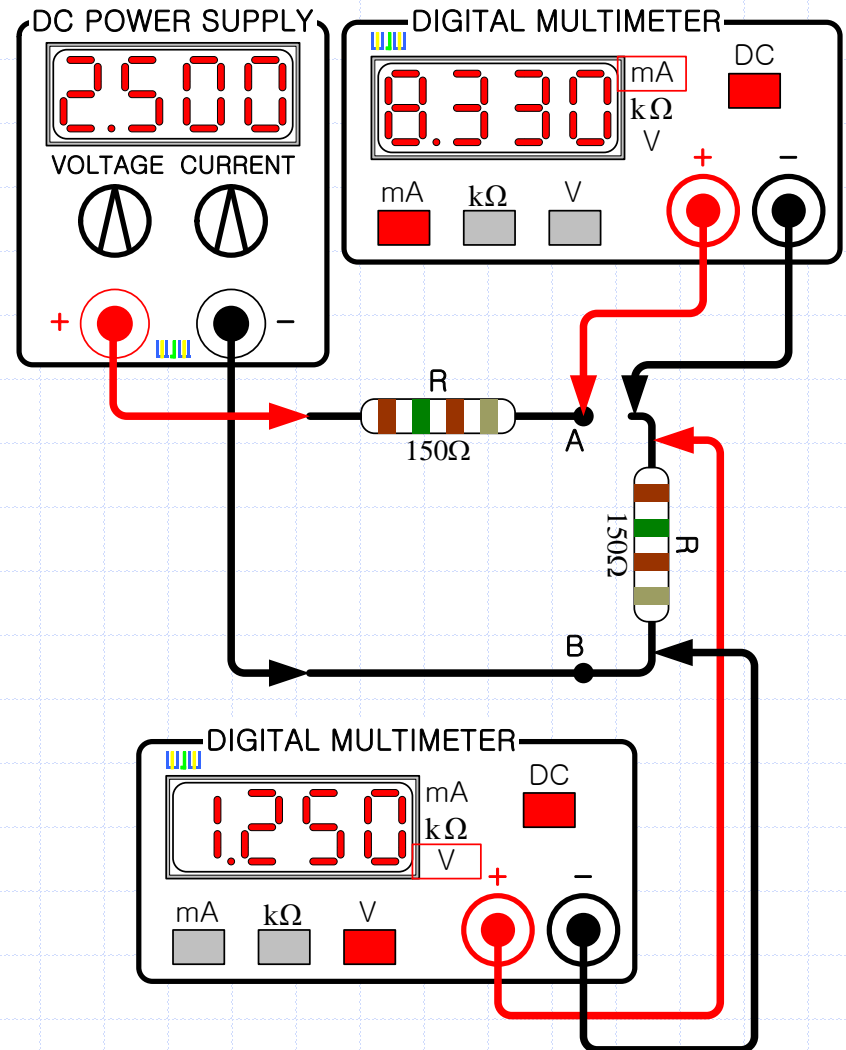
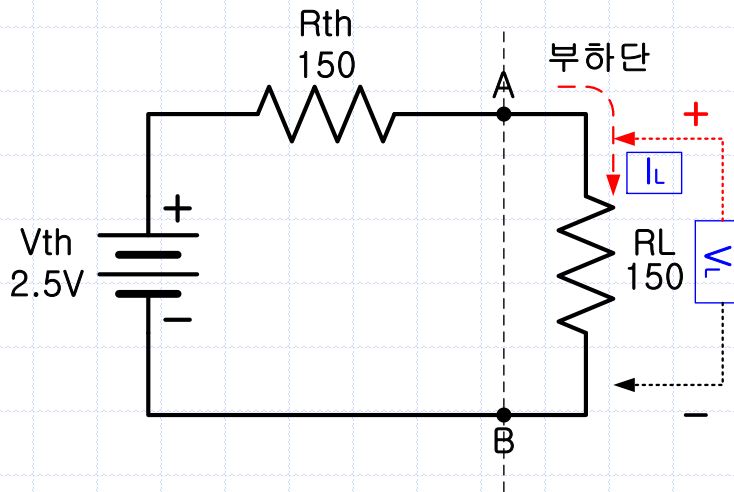
B



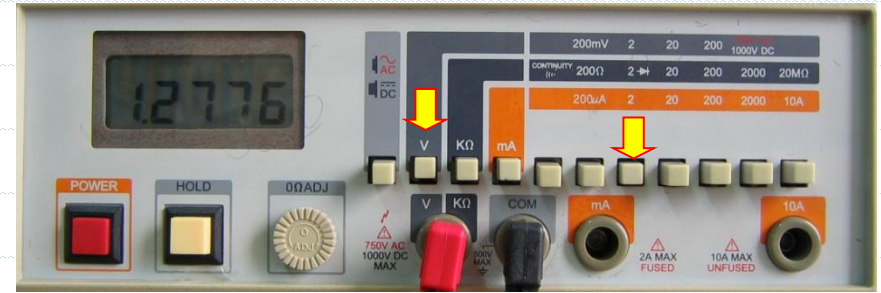
6-7. 테브넨의 등가 회로



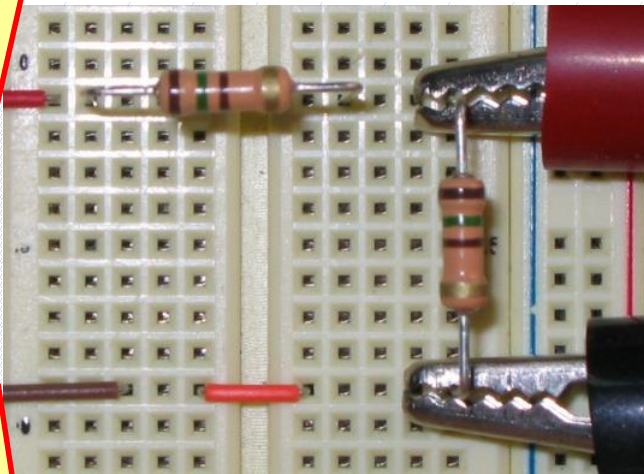
6-8A. 테브넨 등가를 이용한 측정



6-8A. 테브넨 등가를 이용한 측정

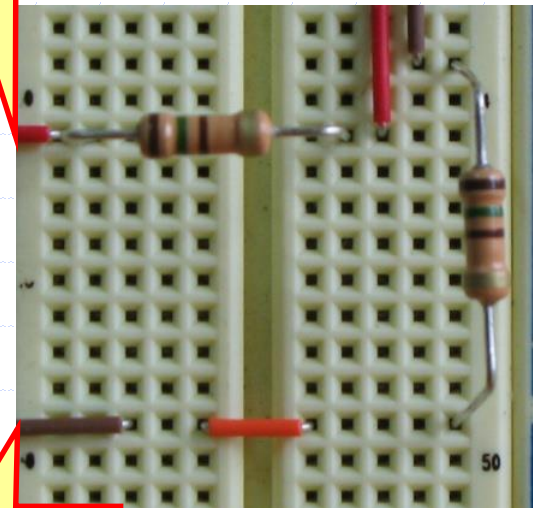


+2.5V

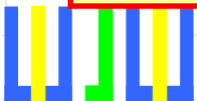


GND

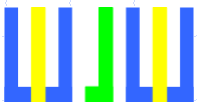
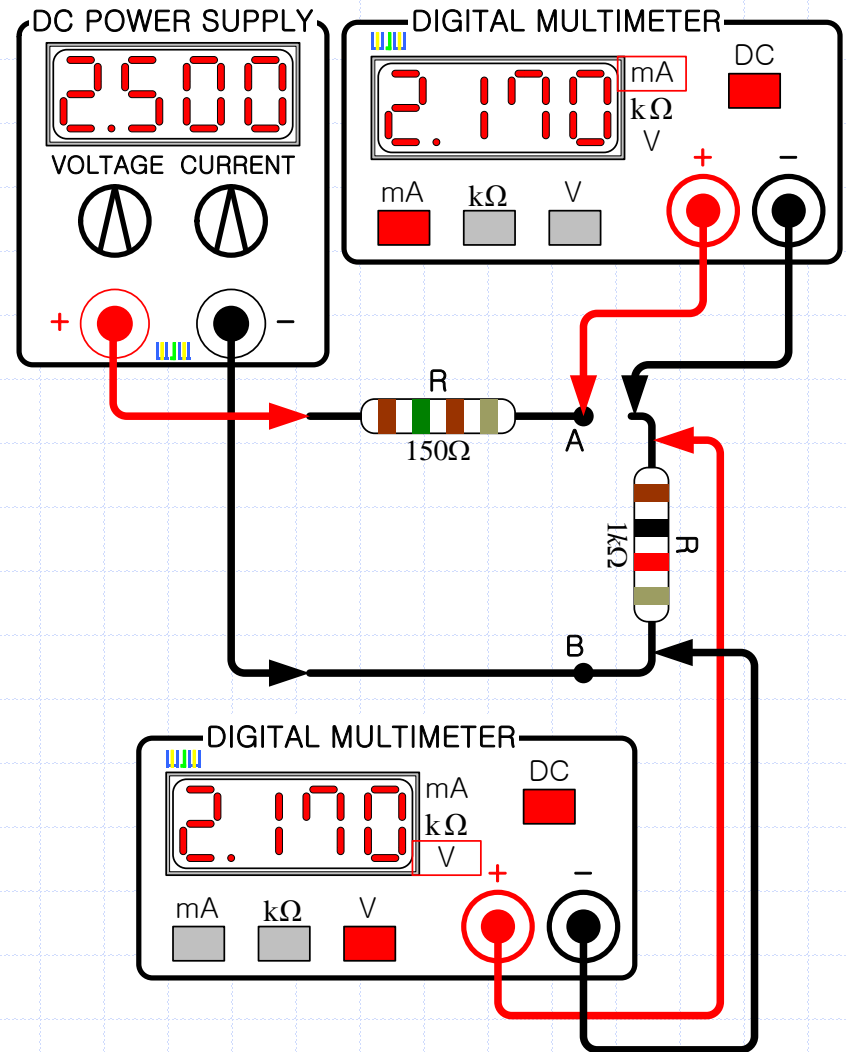
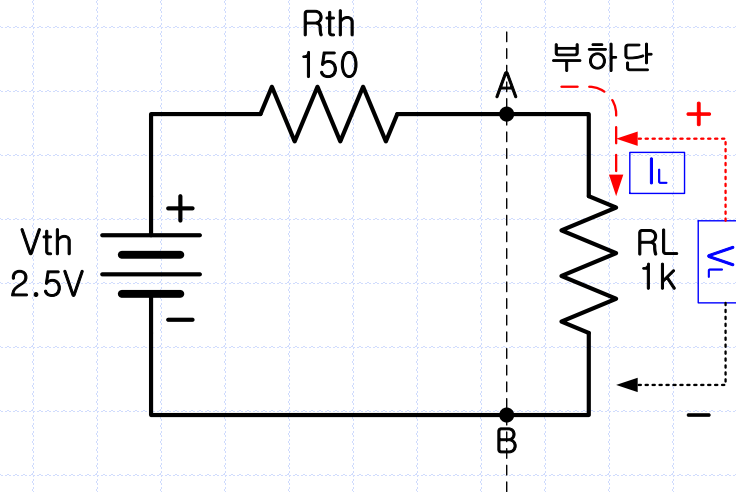
+2.5V



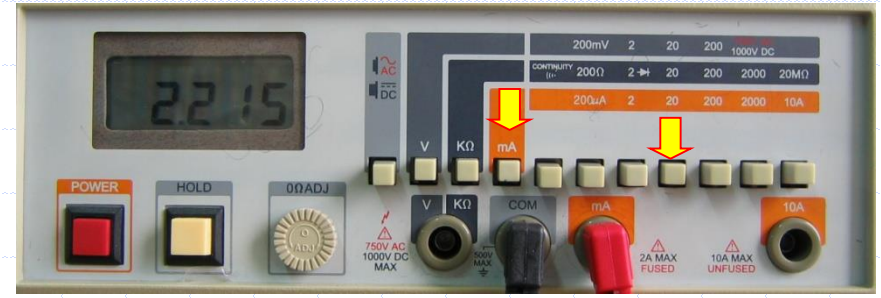
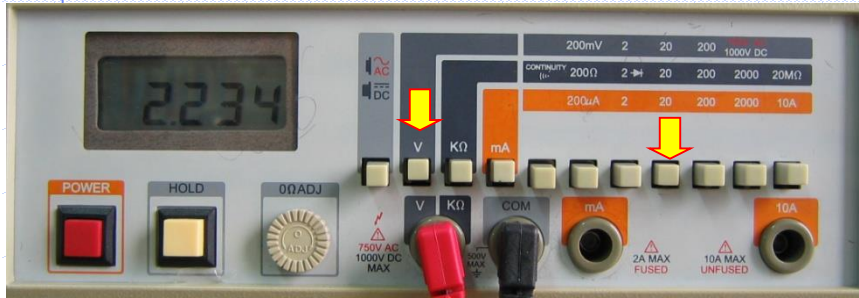
GND



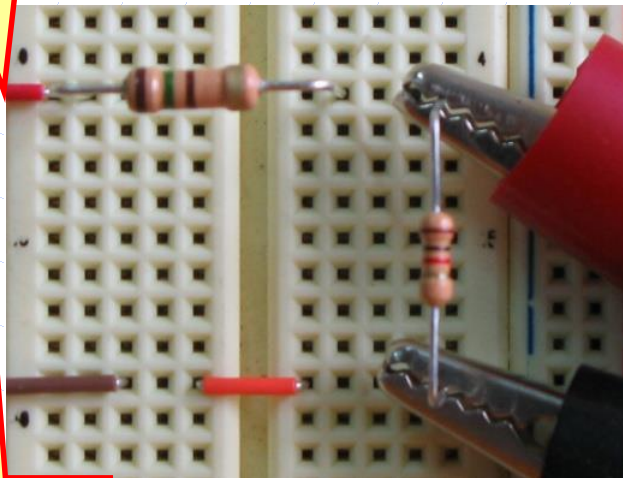
6-8B. 테브넨 등가를 이용한 측정



6-8B. 테브넨 등가를 이용한 측정

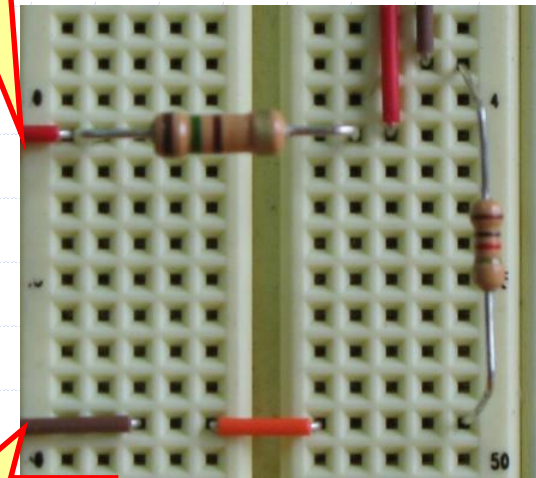


+2.5V

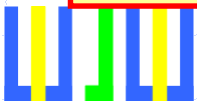


GND

+2.5V



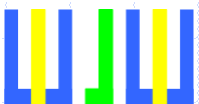
GND



6-9. 테브넨 등가를 이용한 측정 비교

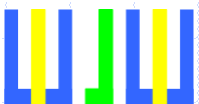
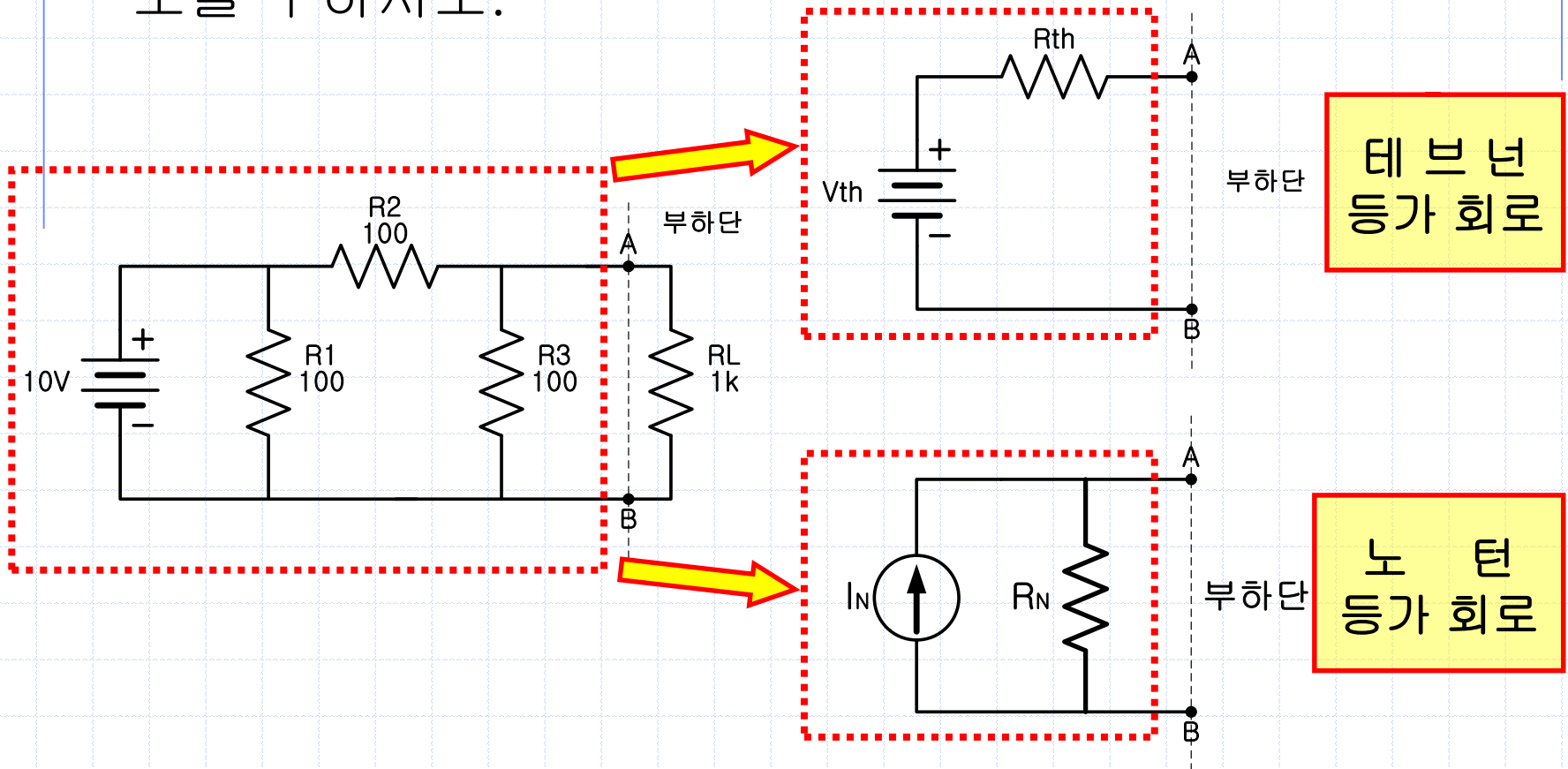
항 목	측정값	기대값
Vth	2.497V	2.5V
Rth	148.17Ω	150Ω

부 하 저항값	부하단의 전류			부하단의 전압		
	원회로	테브넨 등가	기대값	원회로	테브넨 등가	기대값
150	8.119mA	8.286mA	8.33mA	1.2516V	1.2776V	1.25V
1k	2.157mA	2.215mA	2.17mA	2.172V	2.234V	2.17V



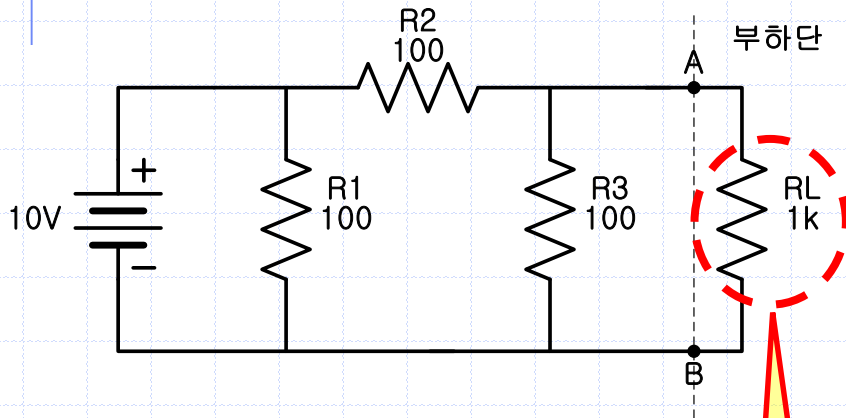
6-10. 테브넨과 노턴의 등가 회로 예제

✓ 다음 회로를 테브넨과 노턴의 정리를 이용하여 등가 회로를 구하시오.

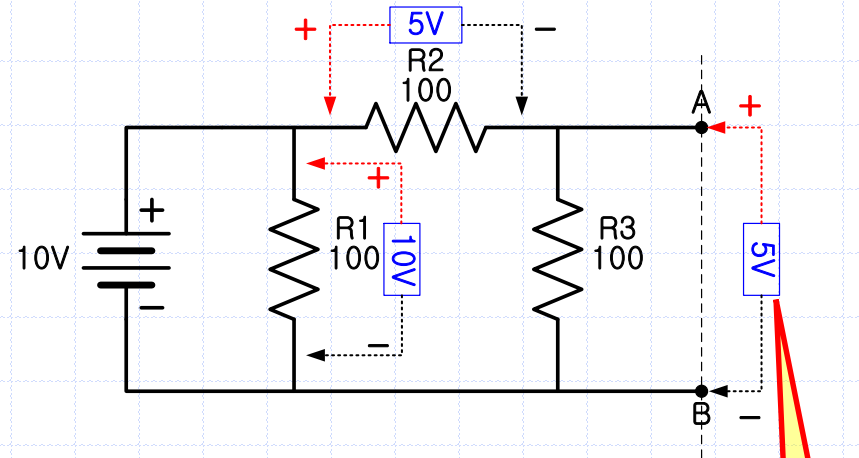


6-10A. 테브넨과 노턴의 등가 회로 예제

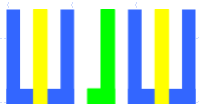
- ✓ 테브넨의 등가 전압원 (V_{th}) : 임의의 회로에서 부하를 제거하고 A-B점 양단의 전압



제거

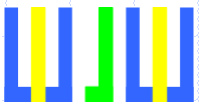
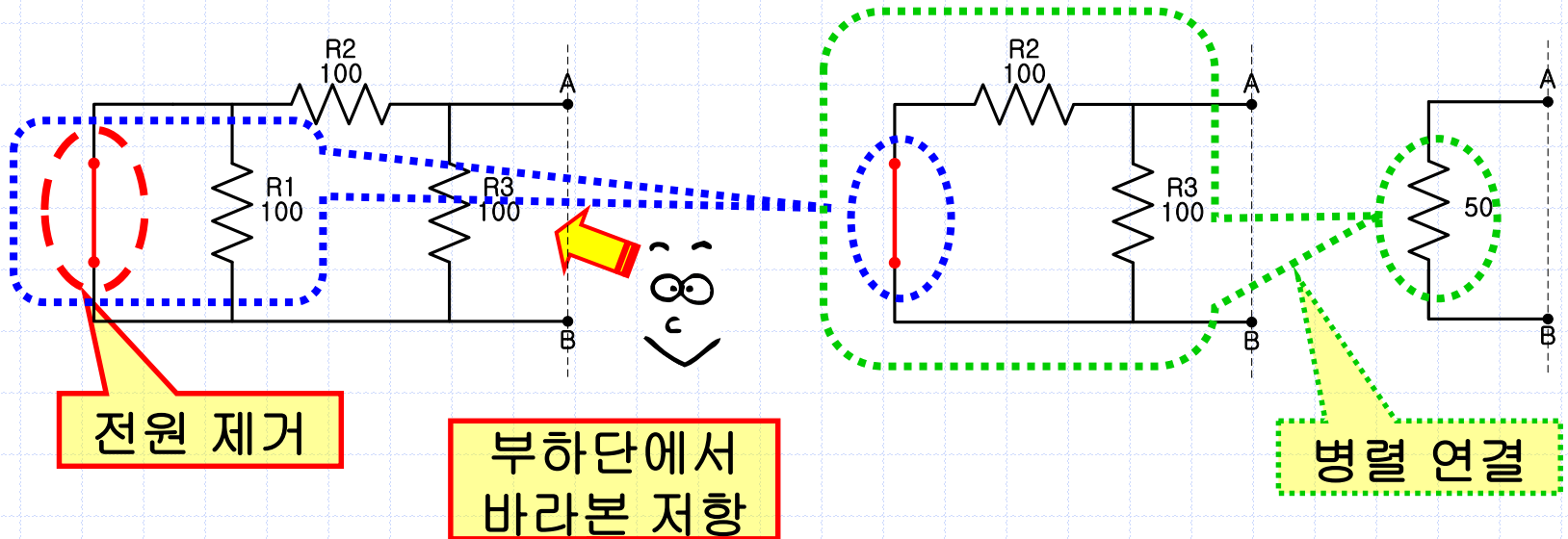


V_{th}



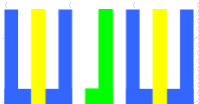
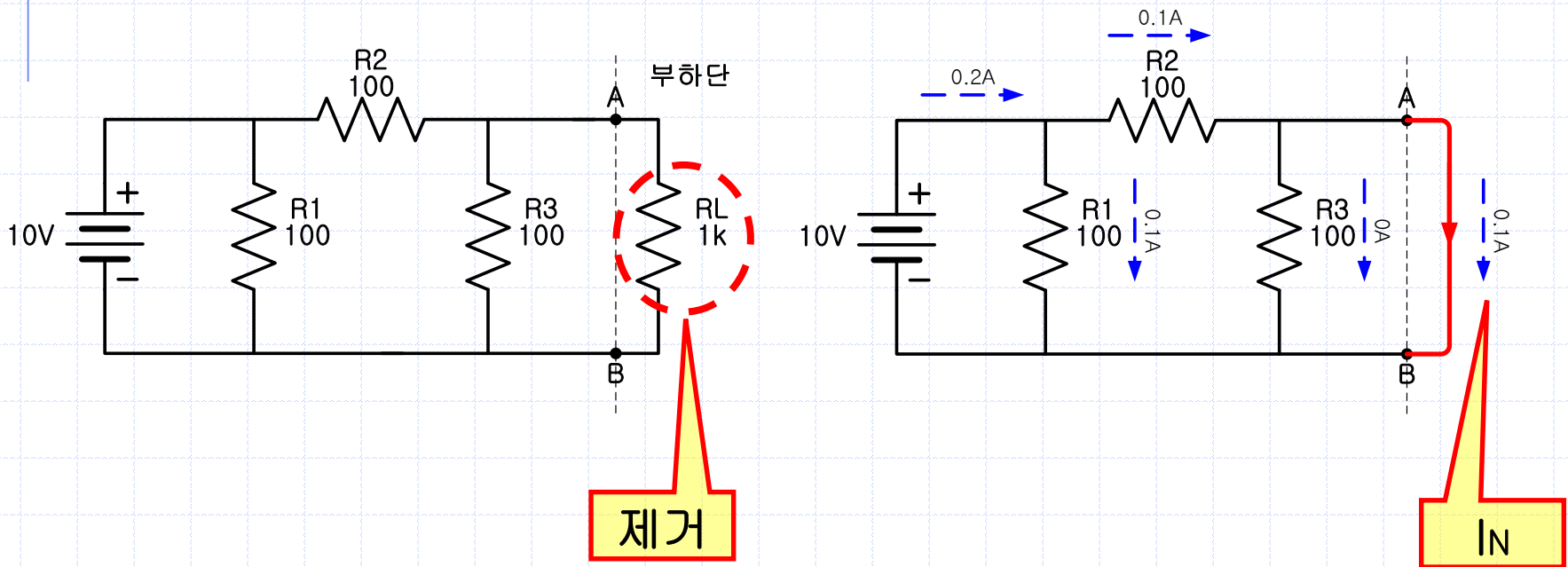
6-10A. 테브넨과 노턴의 등가 회로 예제

- ✓ 테브넨의 등가 저항 (R_{th}) : 임의의 회로에서 전원 및 부하를 제거하고 부하단에서 바라본 저항
- ✓ 전원 제거 방법 : 전압원 (단락), 전류원 (개방)



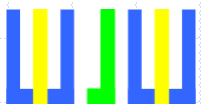
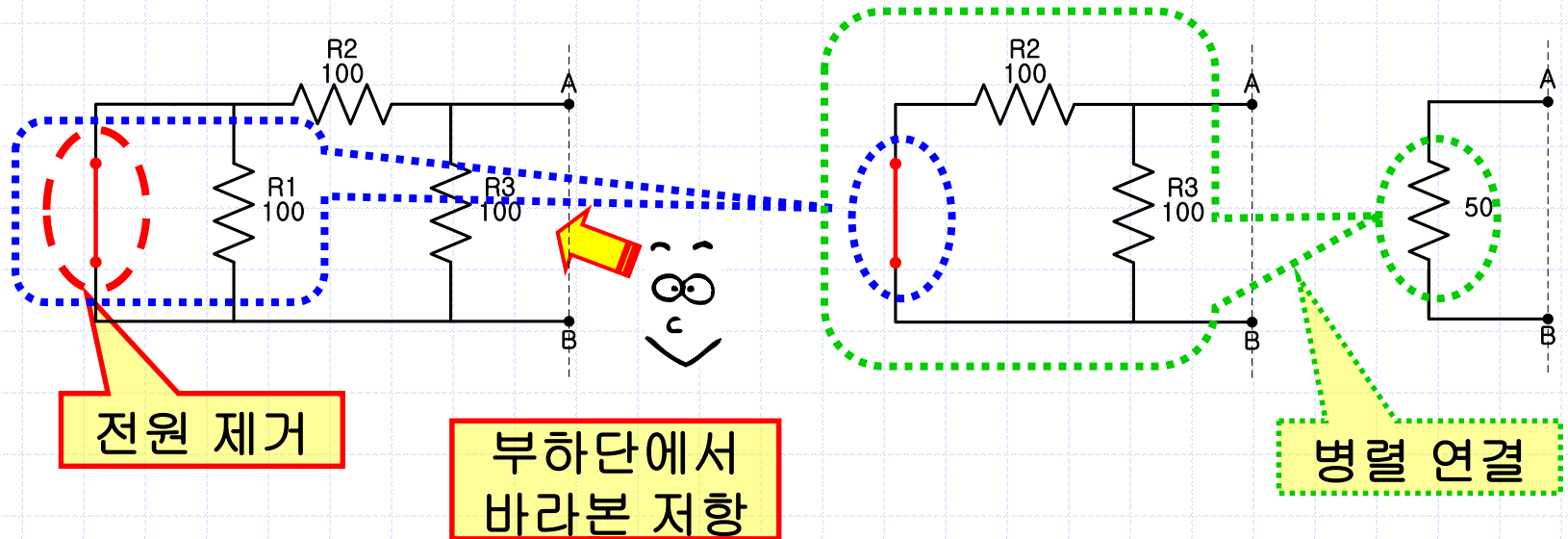
6-10B. 테브넨과 노턴의 등가 회로 예제

- ✓ 노턴의 등가 전류원 (I_N) : 임의의 회로에서 부하를 제거하고 A-B점에 흐르는 전류



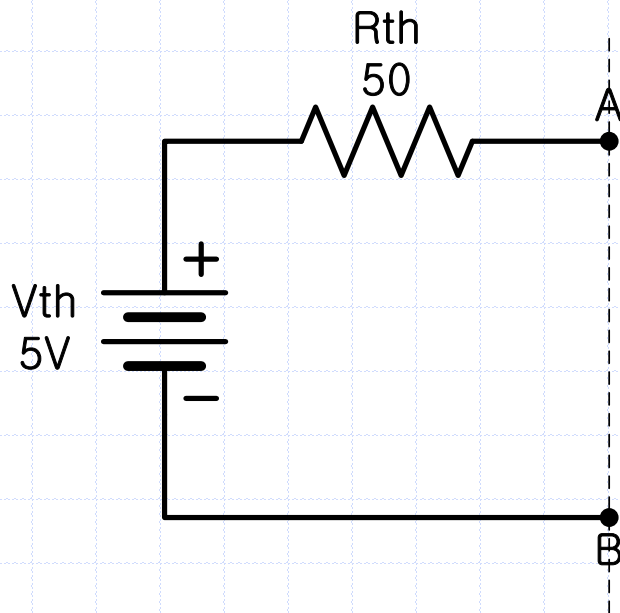
6-10B. 테브넨과 노턴의 등가회로 예제

- ✓ 노턴의 등가 저항 (R_N) : 임의의 회로에서 전원 및 부하를 제거하고 부하단에서 바라본 저항
- ✓ 전원 제거 방법 : 전압원 (단락), 전류원 (개방)

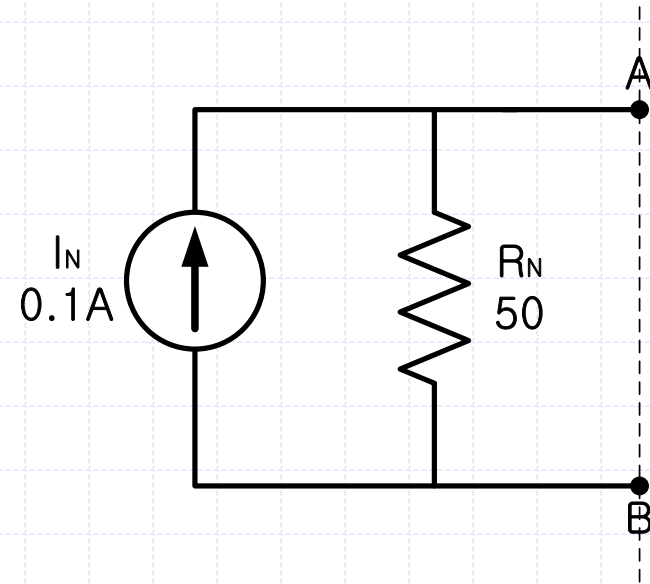


6-10C. 테브넨과 노턴의 등가 회로 예제

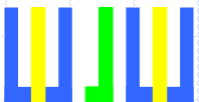
- ✓ 테브넨의 등가 회로 (이론)
- ✓ 노턴의 등가 회로 (이론)



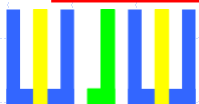
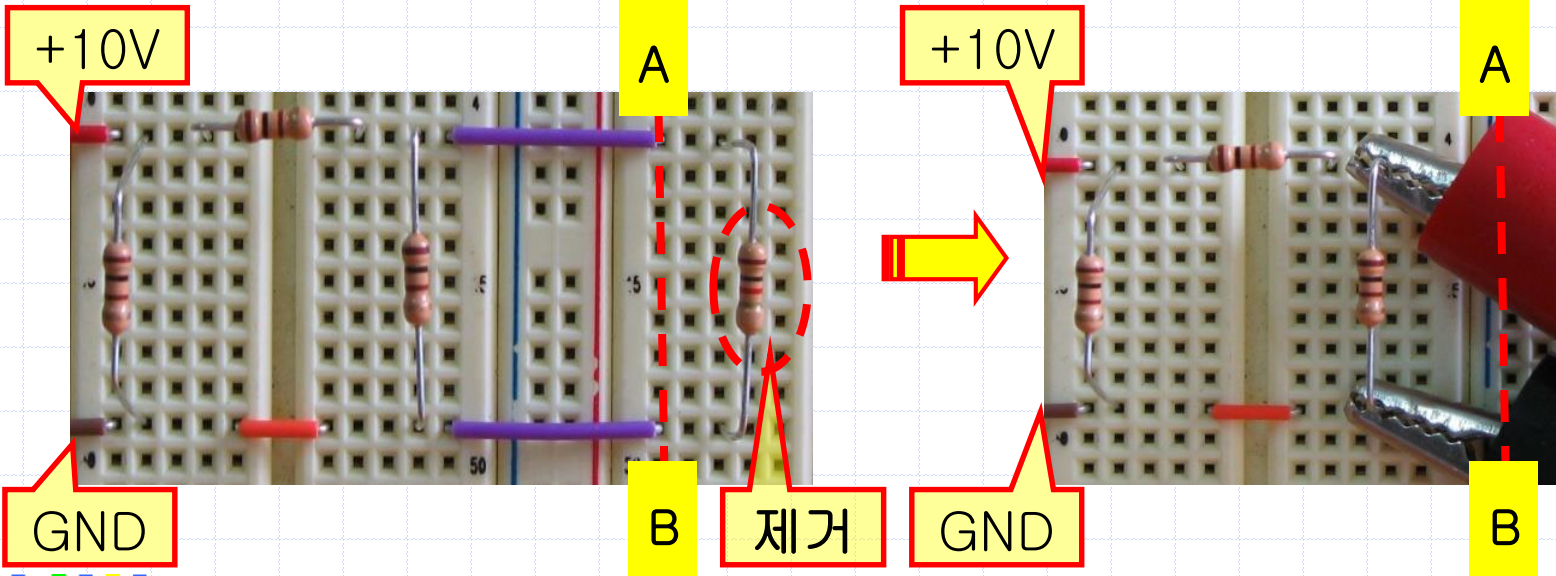
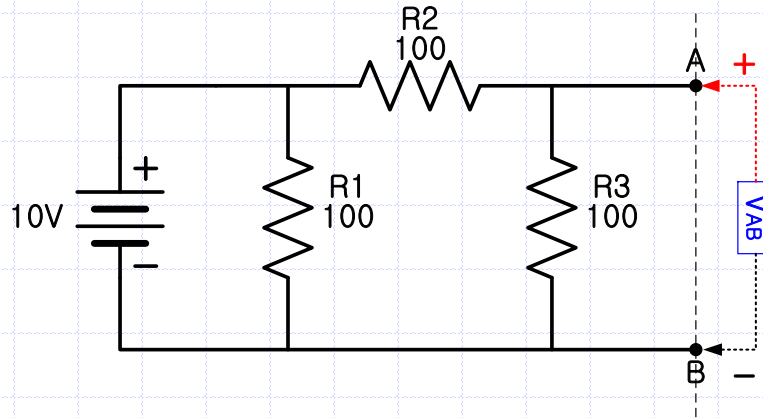
부하단



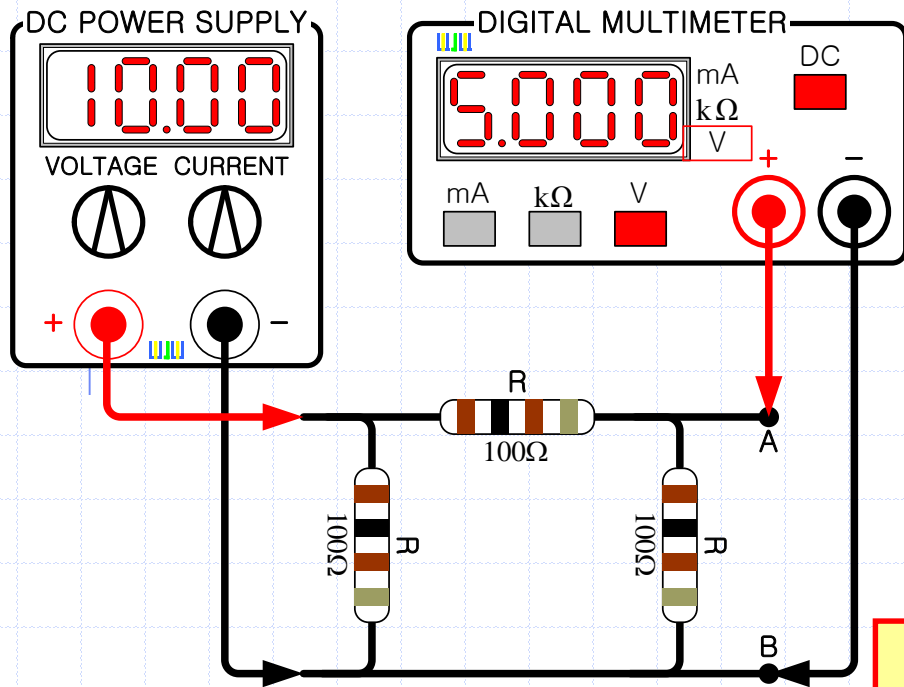
부하단



6-10D. 테브넨과 노턴의 등가 회로 예제

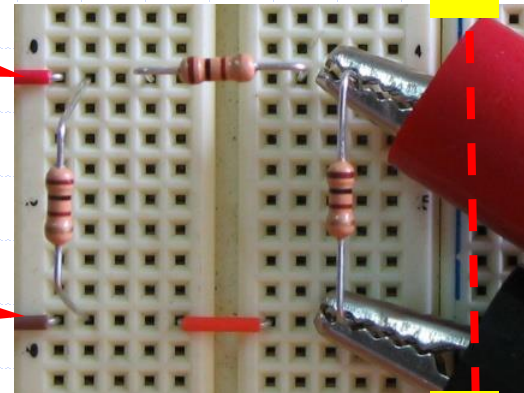


6-10D. 테브넨과 노턴의 등가 회로 예제



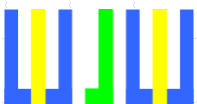
+10V

GND

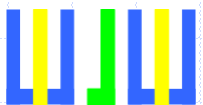
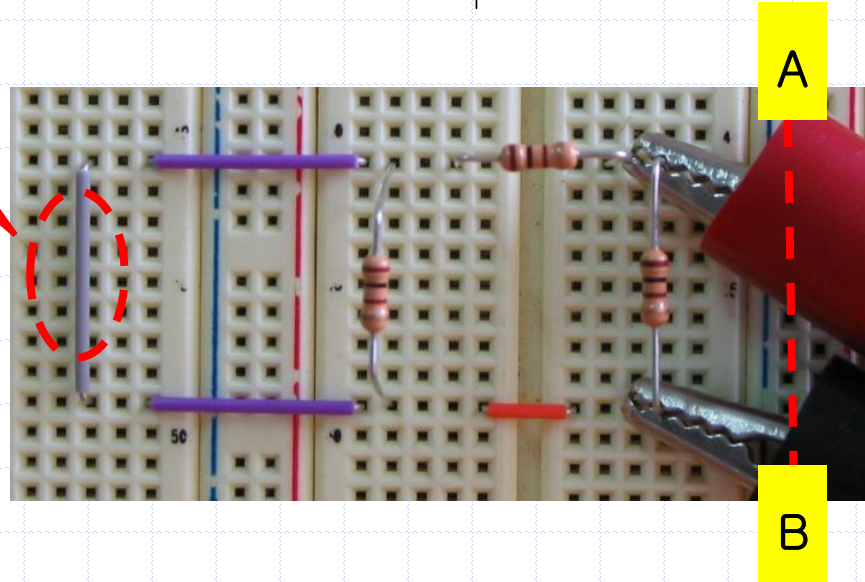
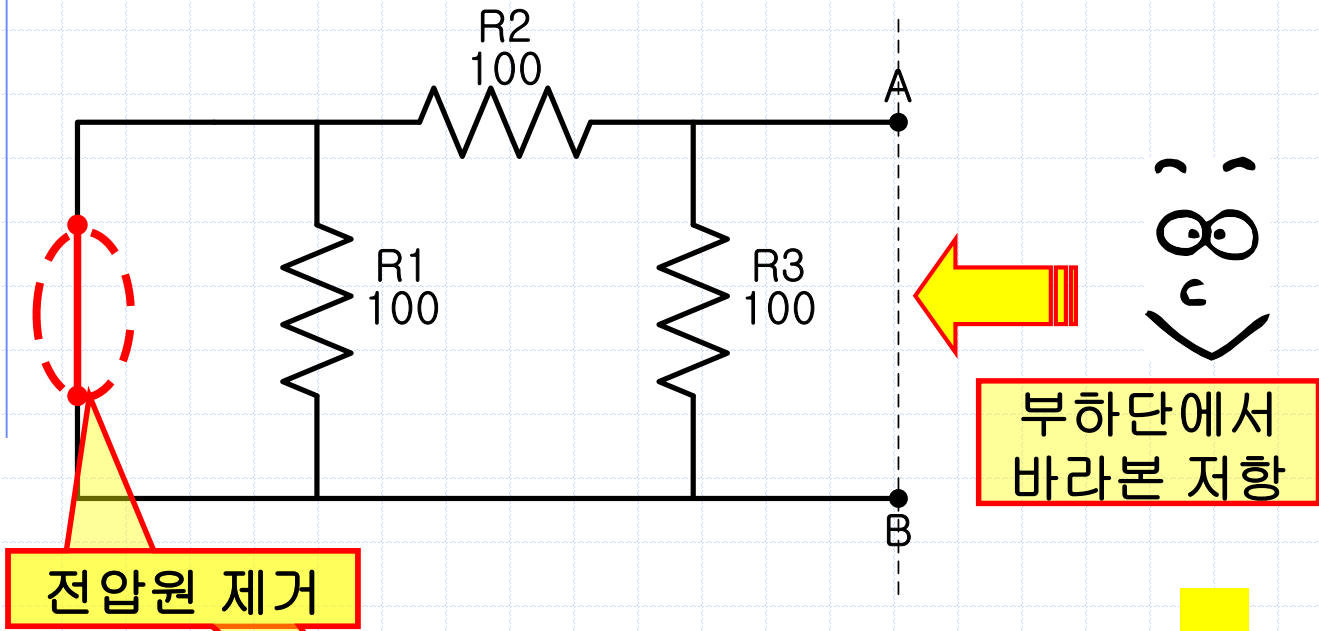


A

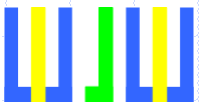
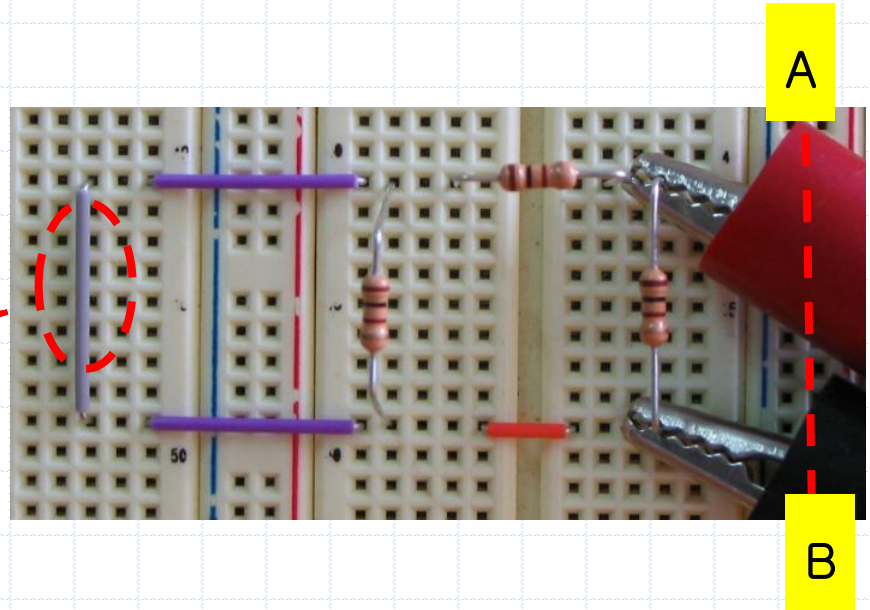
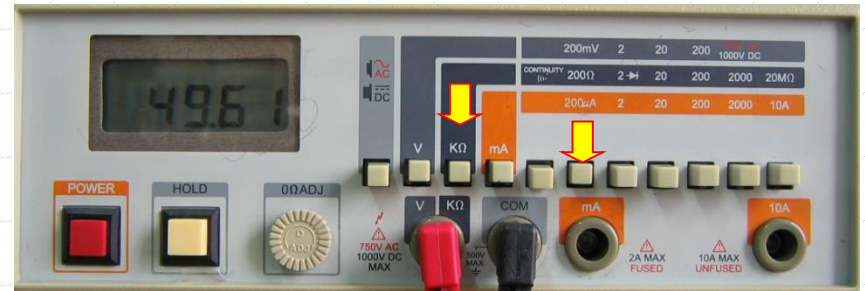
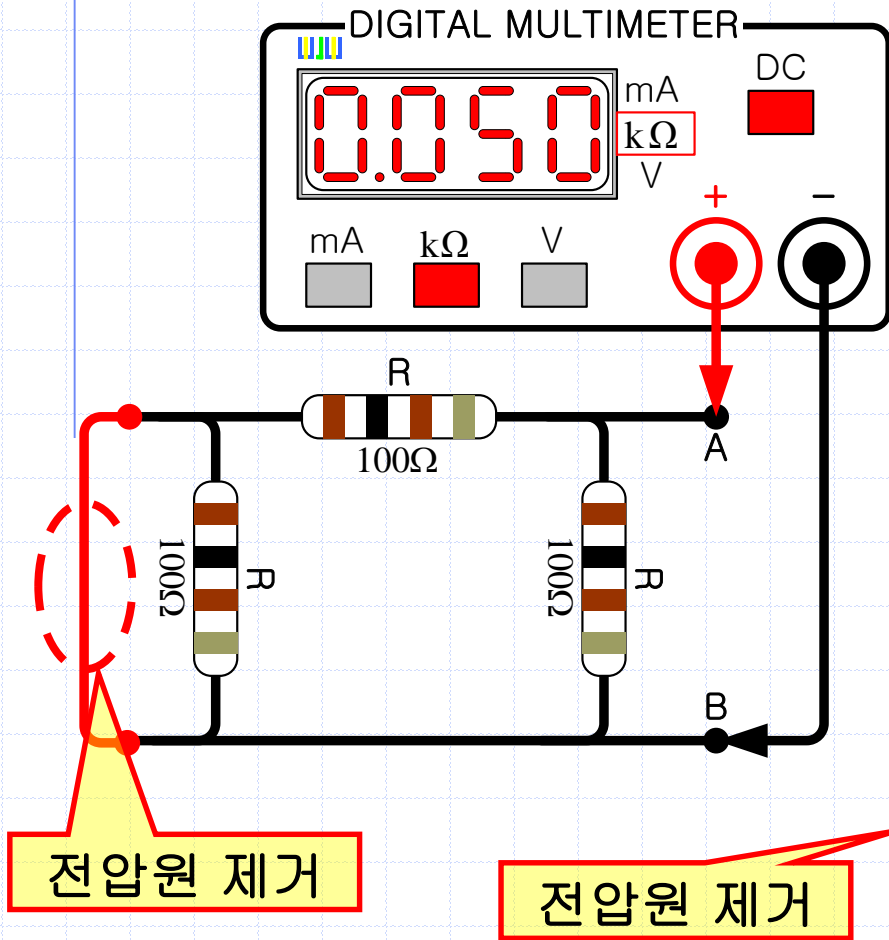
B



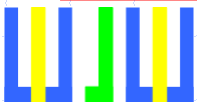
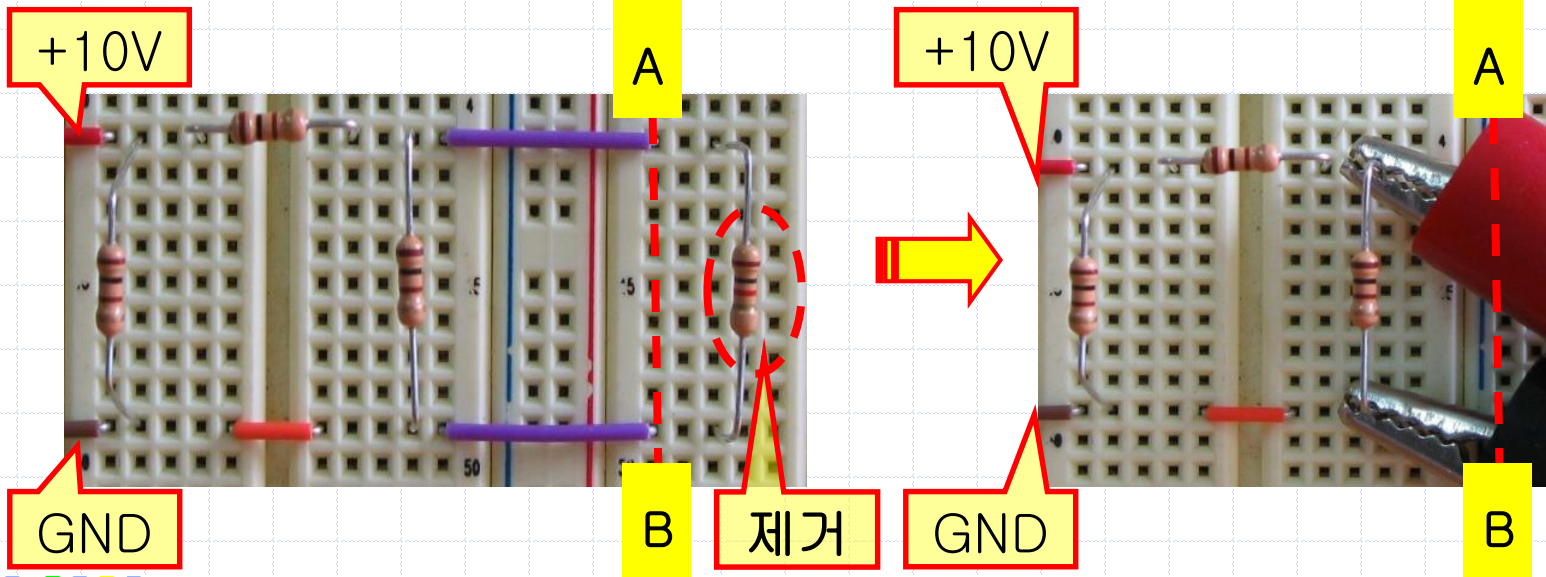
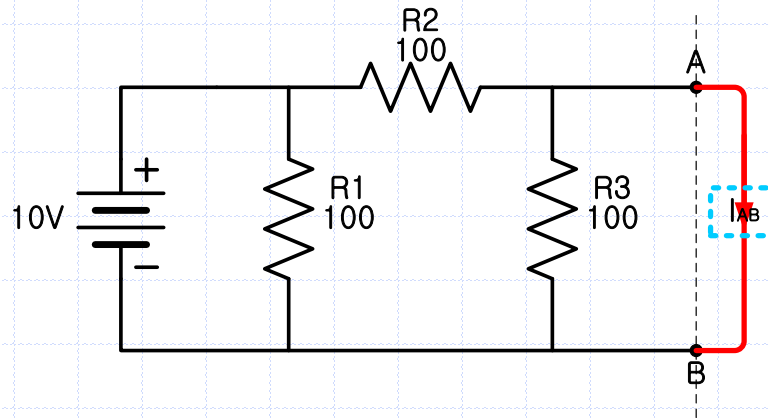
6-10D. 테브넨과 노턴의 등가 회로 예제



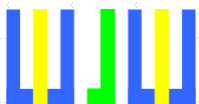
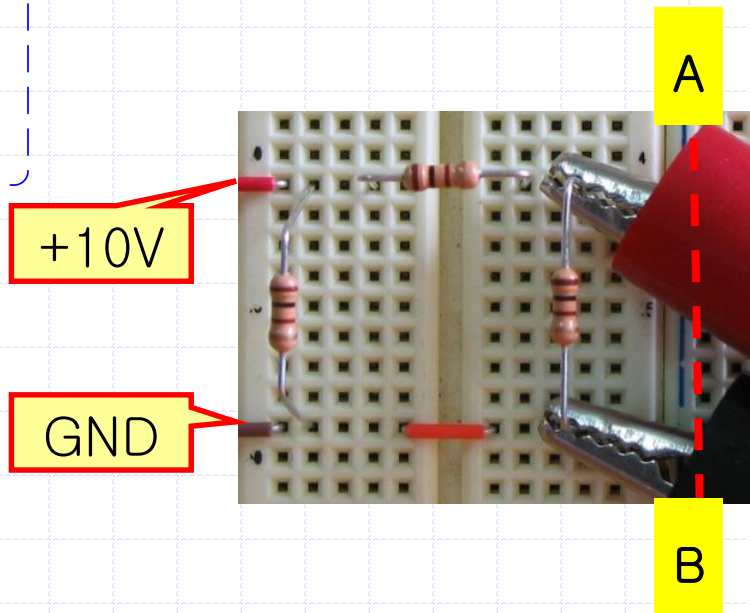
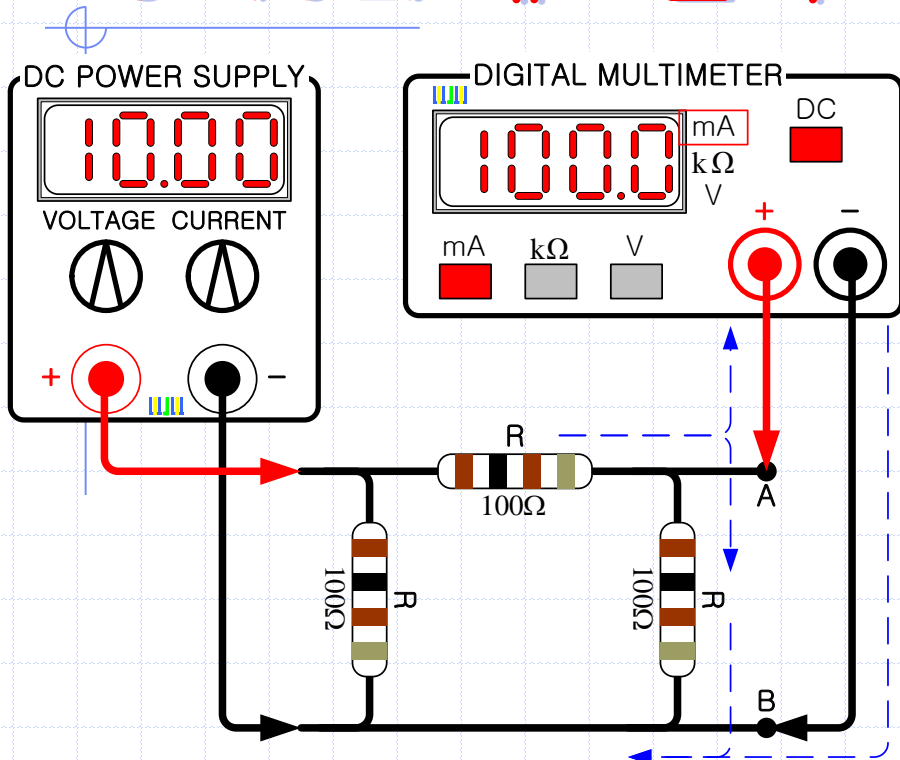
6-10D. 테브넨과 노턴의 등가 회로 예제



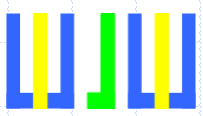
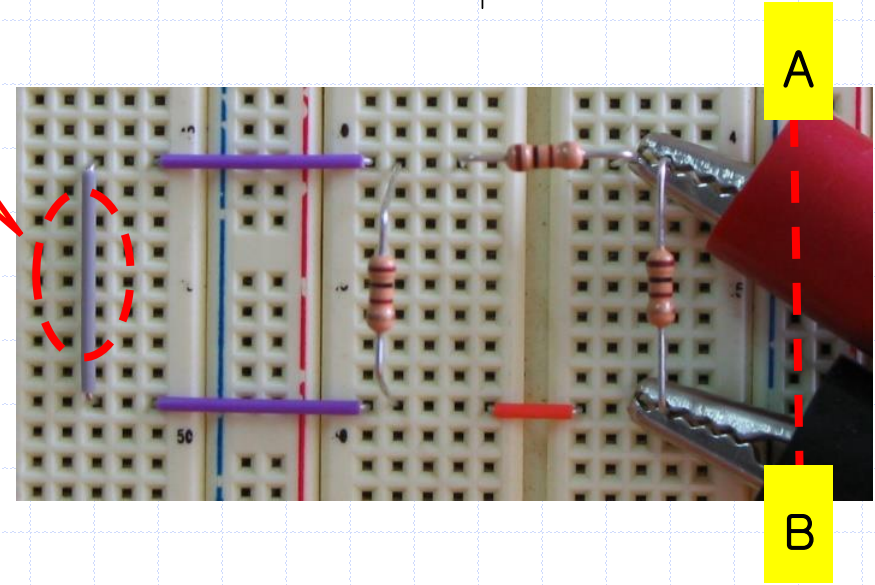
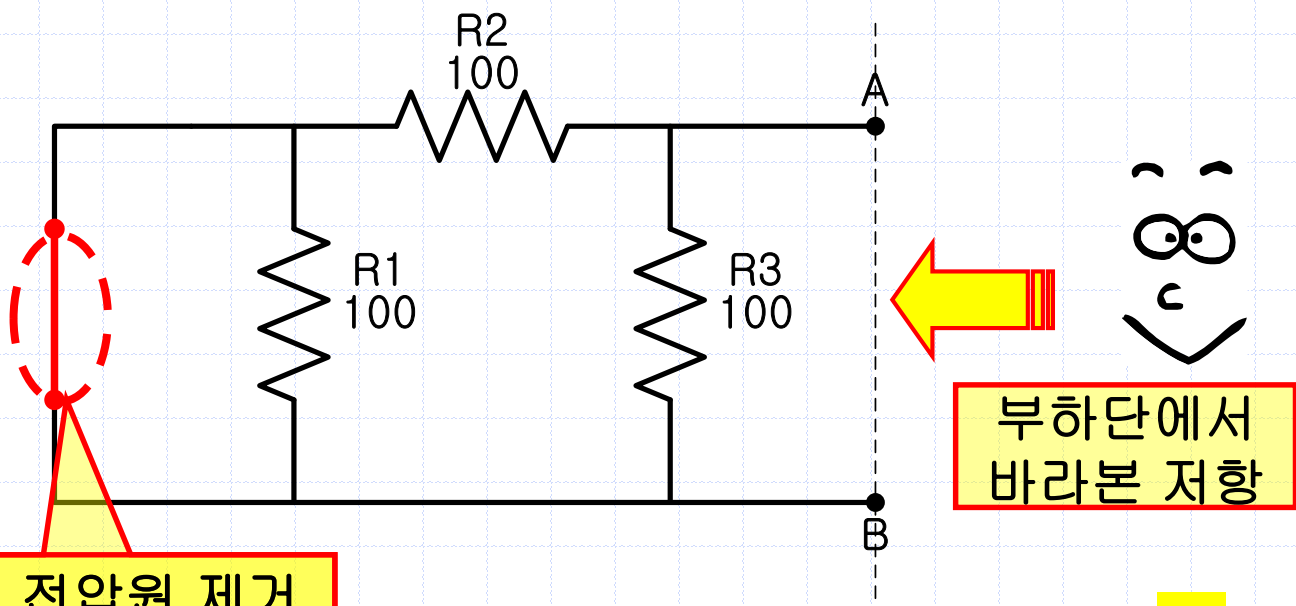
6-10E. 테브넨과 노턴의 등가 회로 예제



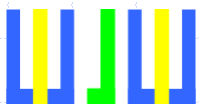
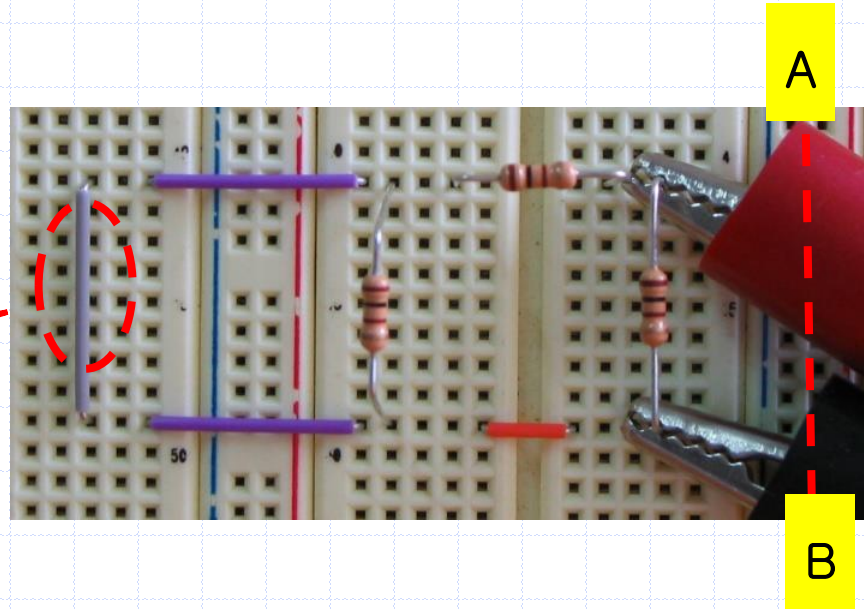
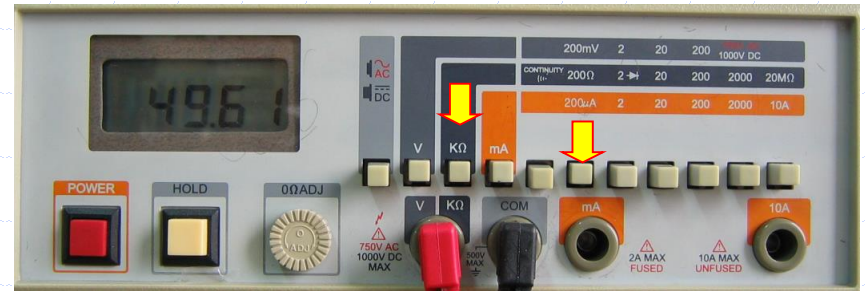
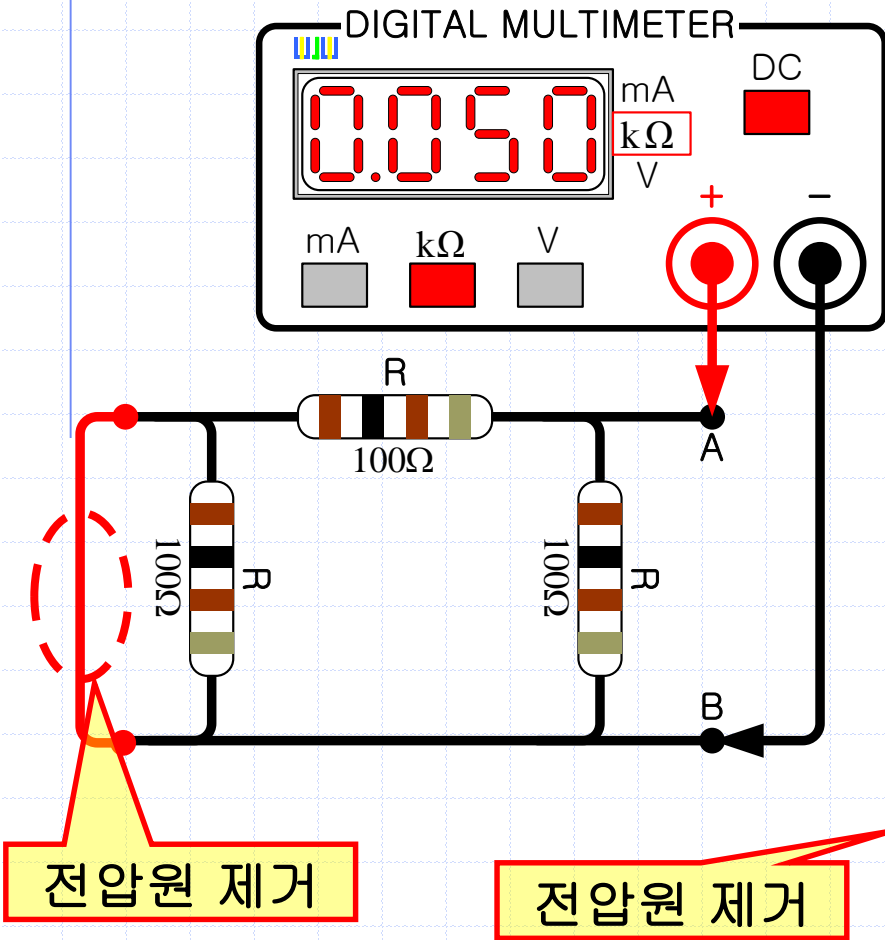
6-10E. 테브넨과 노턴의 등가 회로 예제



6-10E. 테브넨과 노턴의 등가 회로 예제



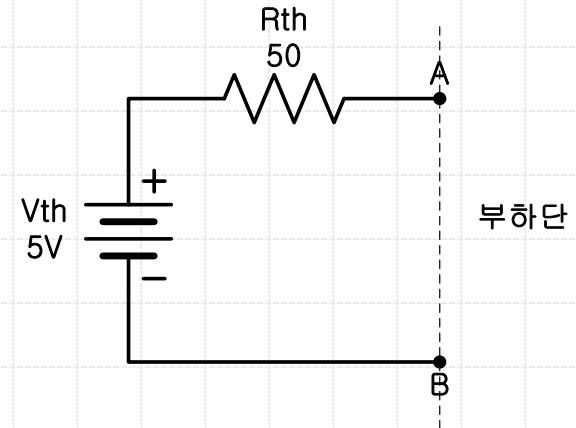
6-10E. 테브넨과 노턴의 등가 회로 예제



6-10F. 테브넨과 노턴의 등가 회로 예제

✓ 테브넨 등가 회로

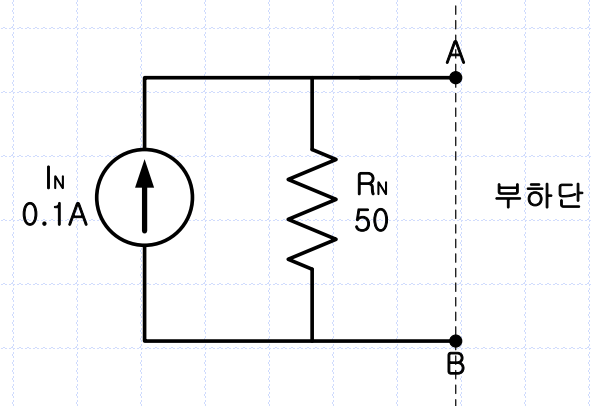
항 목	측정값	기대값
Vth	4.879 V	5 V
Rth	49.61 Ω	50 Ω



$$V_{TH} = I_N R_N = 100\text{mA} \times 50\Omega = 5\text{V}$$

✓ 노턴 등가 회로

항 목	측정값	기대값
I _N	97.58 mA	100mA
R _N	49.61 Ω	50 Ω



$$I_N = \frac{V_{TH}}{R_{TH}} = \frac{5\text{V}}{50\Omega} = 0.1\text{A} = 100\text{mA}$$

