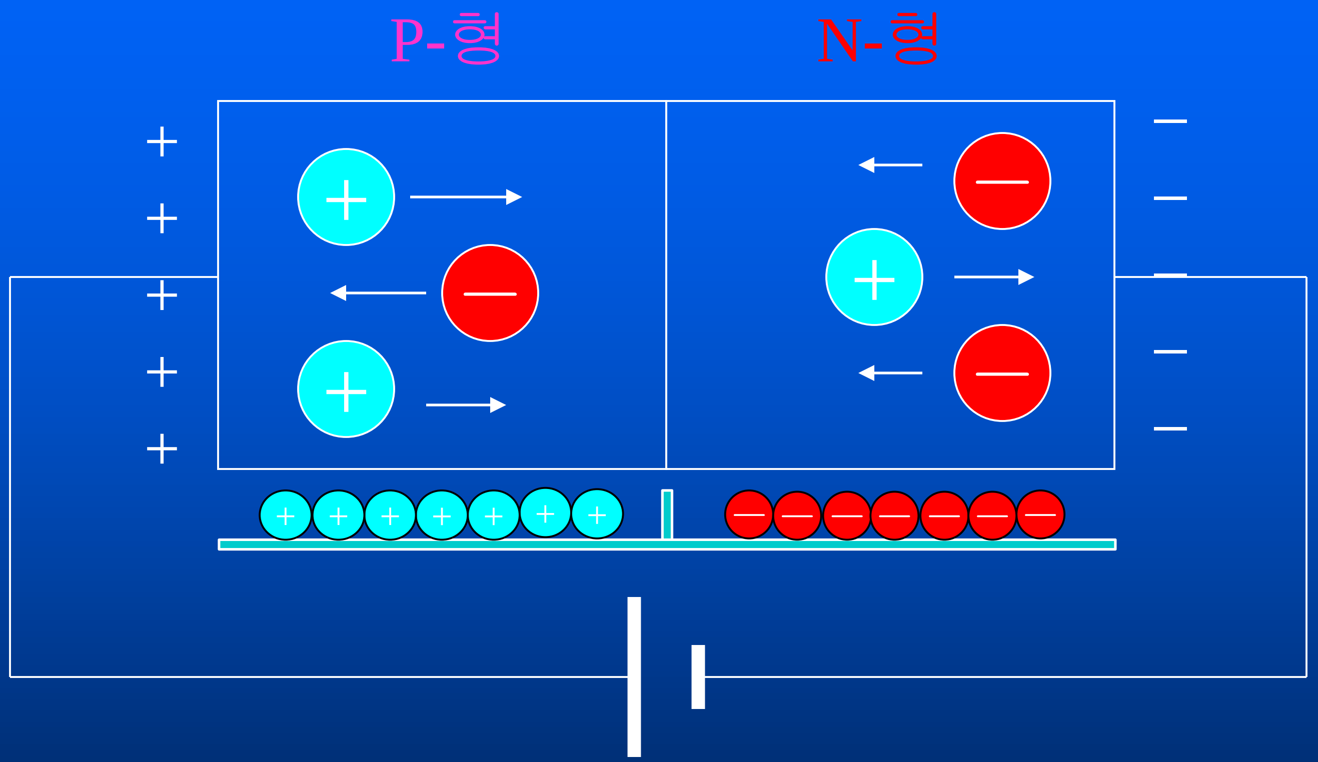
1. 전력전자 소자

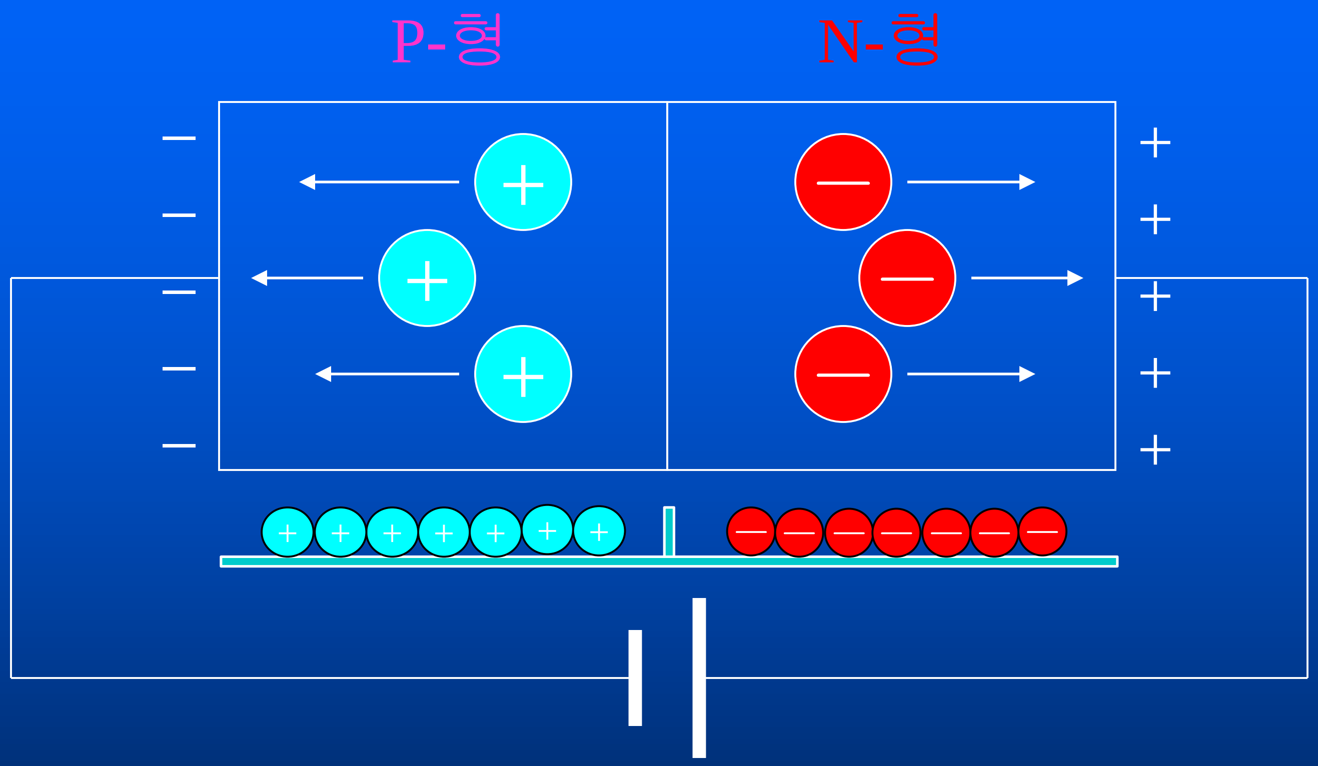
Power Electronics Components

1-1. Diode의 동작원리: 순방향 (Forward)



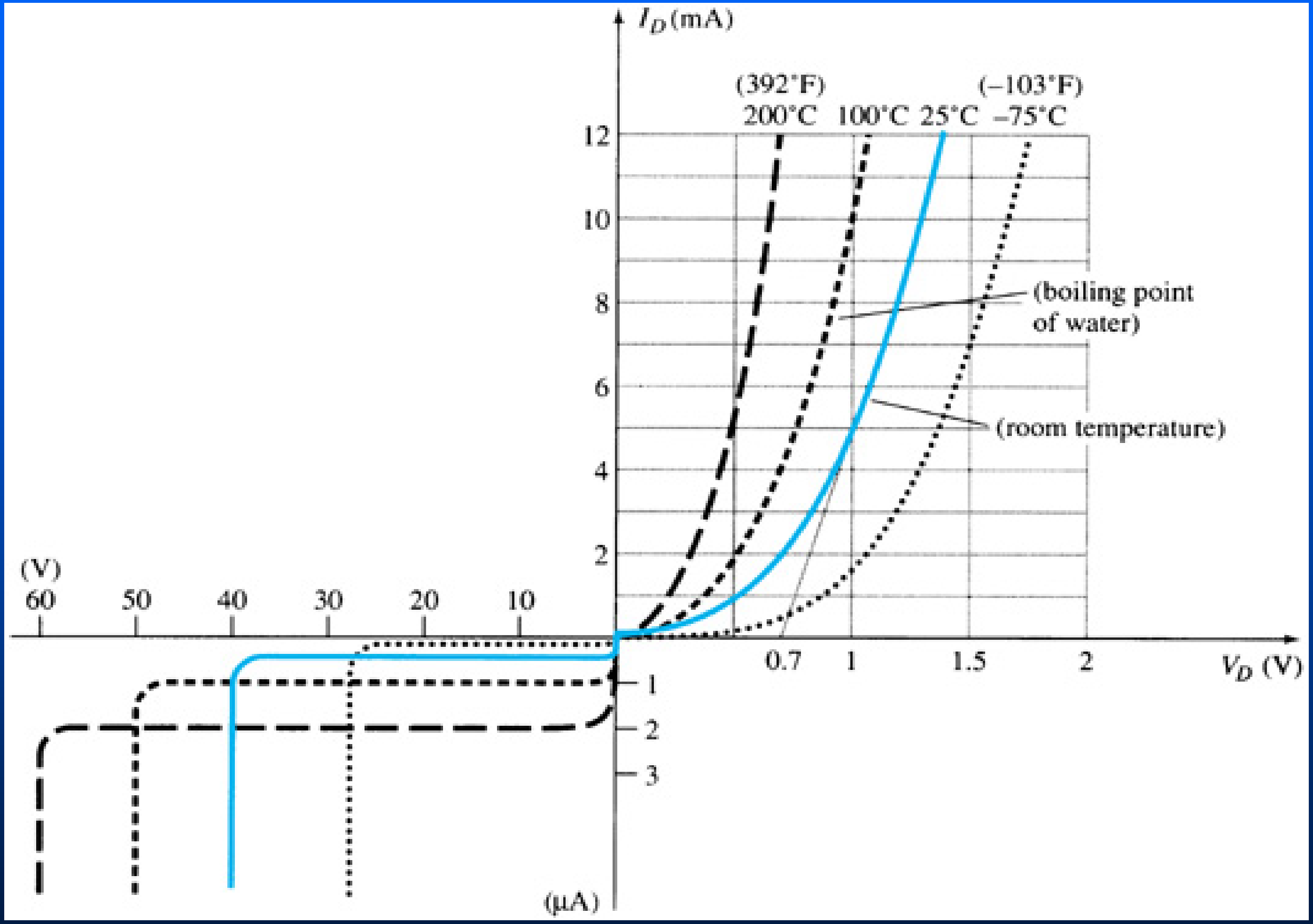
- 전류 = 전자전류 + 정공전류
- 전자는 전류와 반대 방향
- 정공은 전류와 같은 방향

1-2. Diode의 동작원리: 역방향 (Reverse)

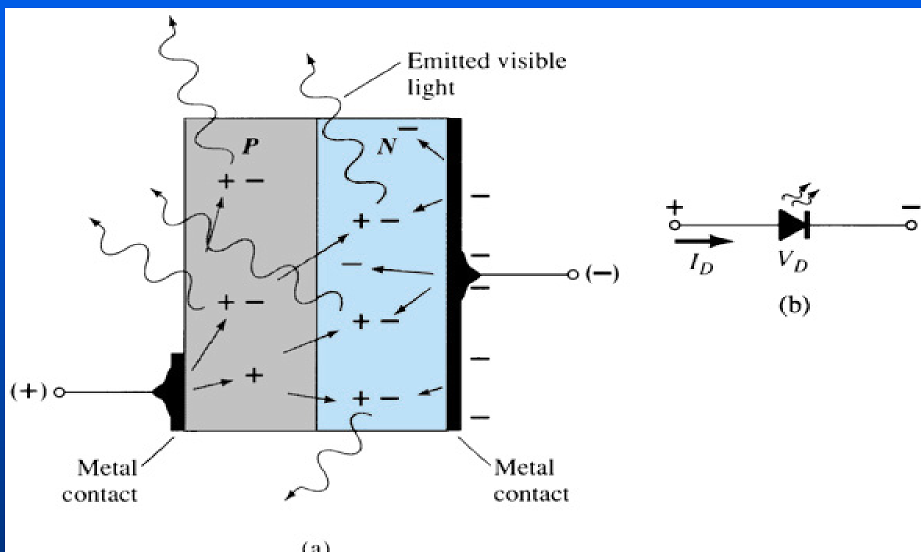


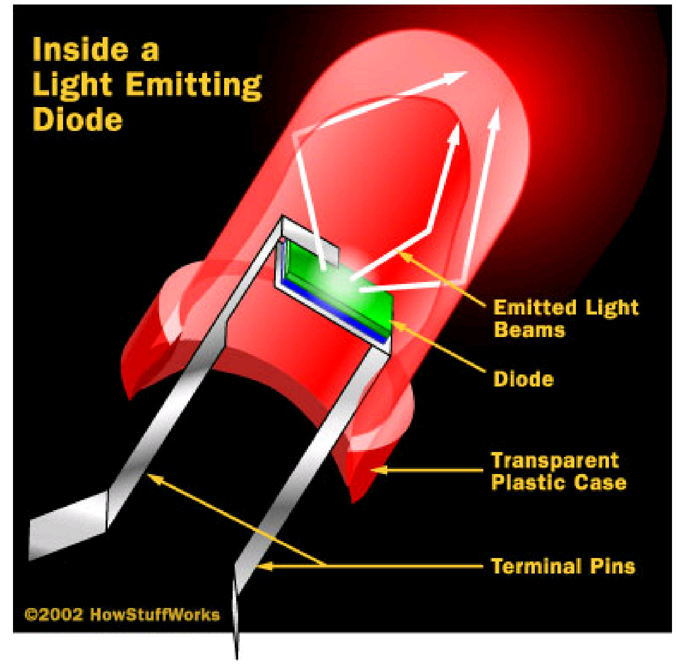
- 전류 = 전자전류 + 정공전류
- 전류가 흐르지 못함

1-4. Diode의 동작원리: 특성 곡선



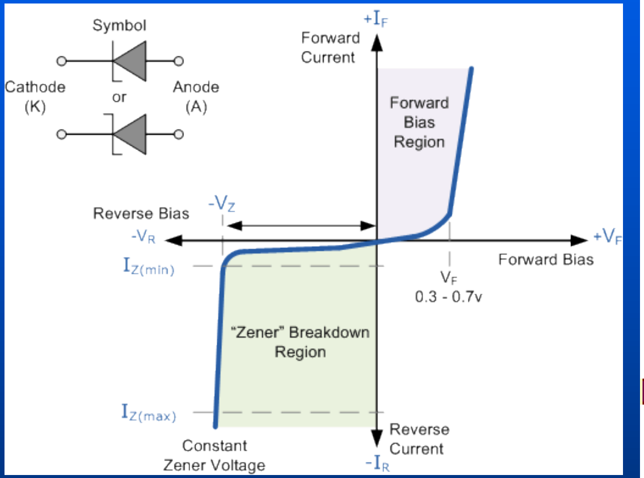
1-5. Diode의 동작원리: LED의 동작

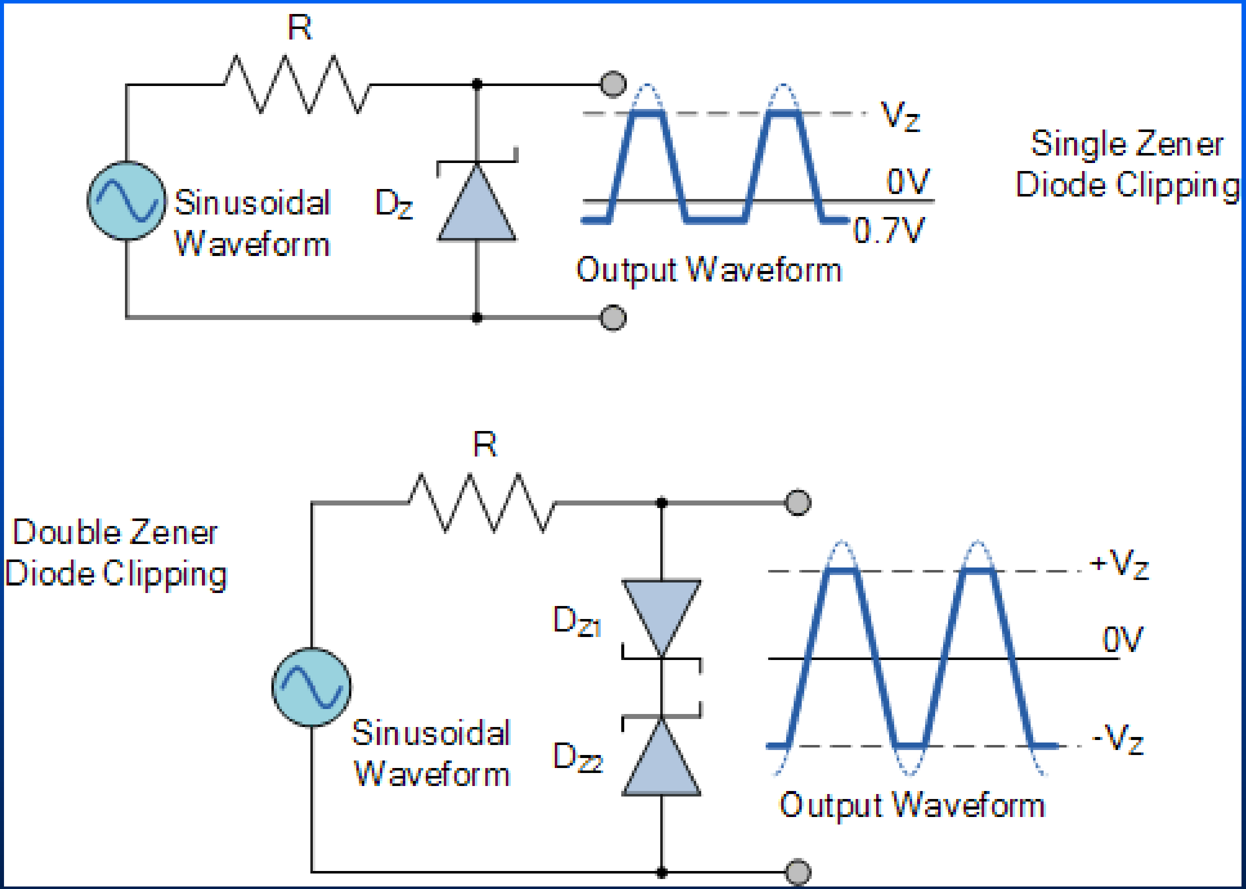




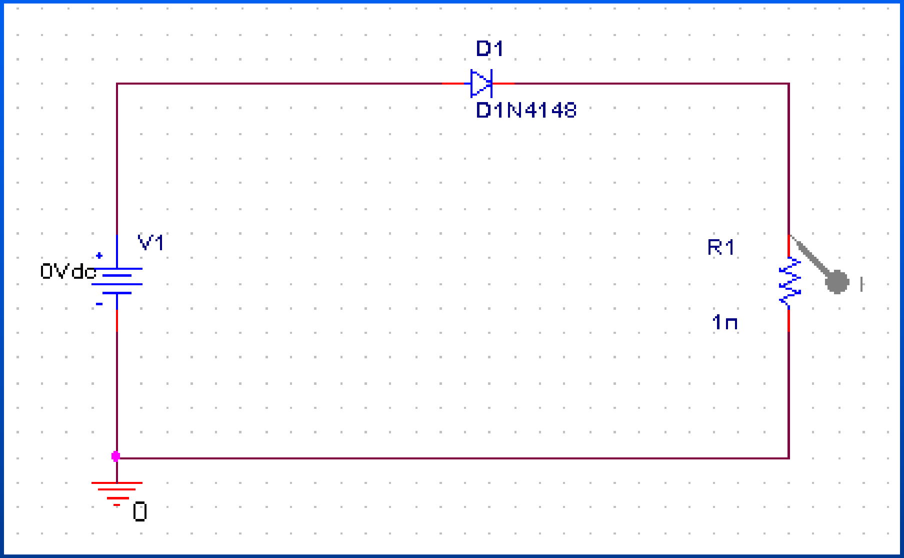
LEDs have several advantages over conventional incandescent lamps. For one thing, they don't have a filament that will burn out, so they last much longer. Additionally, their small plastic bulb makes them a lot more durable. They also fit more easily into modern electronic circuits.

1-6. Diode의 동작원리: Zener Diode의 동작





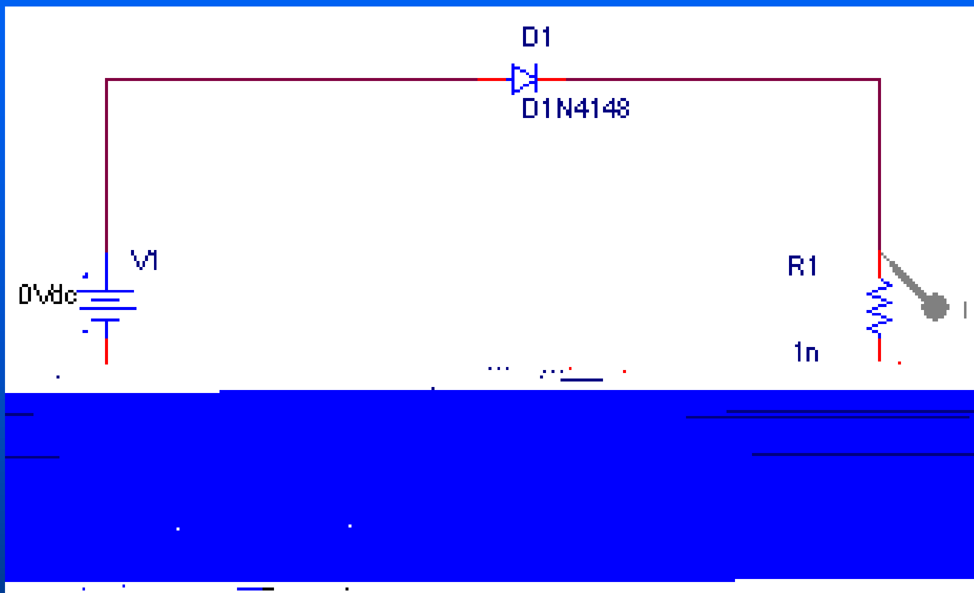
1-7. Diode의 특성 (OrCAD Simulation)



- *Parameter*
  - ✓ *D1N4148/EVAL*
  - ✓ *R(analog)=1 n*
  - ✓ V_1*=0 V*
  - ✓ *Simulation*
  - ✓ *(DC Sweep)*

    -1 0.01 +1 V

1 8. Diode의 온도특성 (OrCAD Simulation)



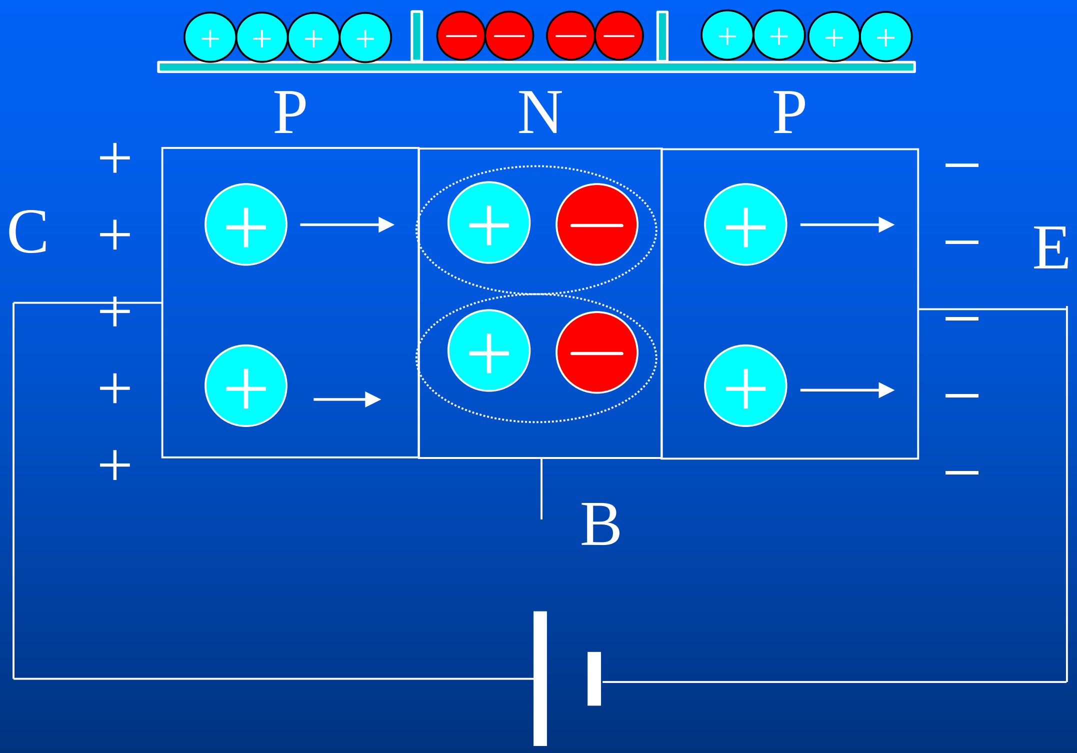
- *Parameter*
  - ✓ *D1N4148/EVAL*
  - ✓ *R(analog)=1 n*
  - ✓ *V_1=0 V Simulation*
  - ✓ *(DC Sweep)*

    -1 0.01 +2 V
  - ✓ *(Parameter)*

    Temperature(sweep)

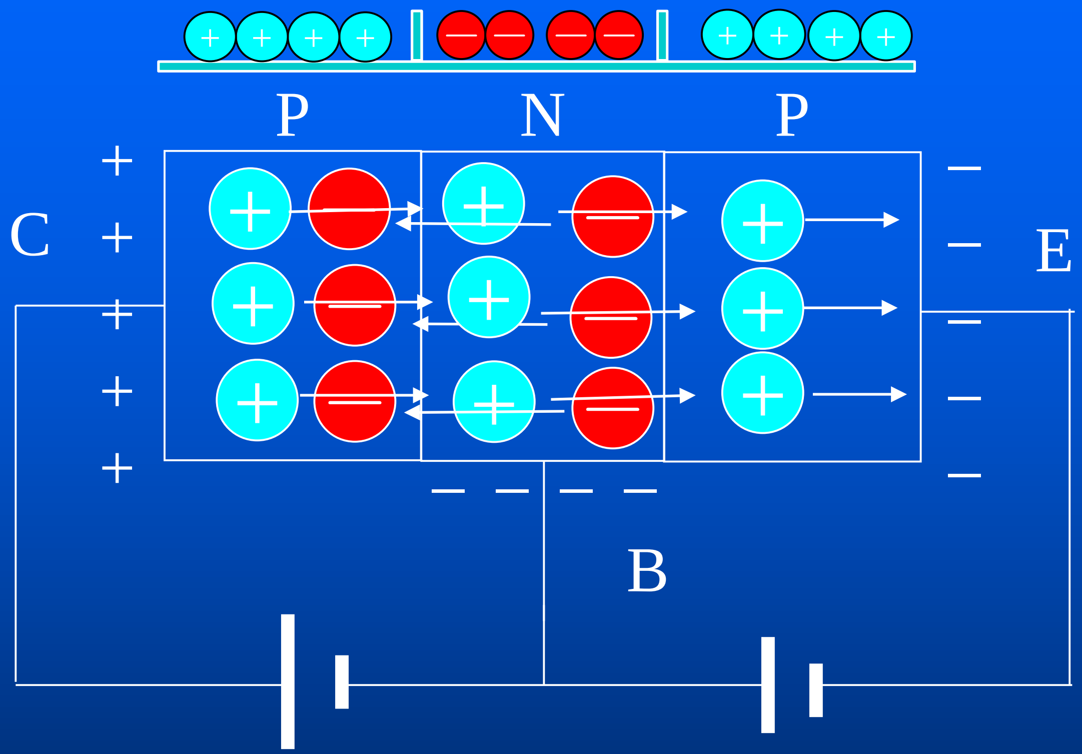
    -100 0 100

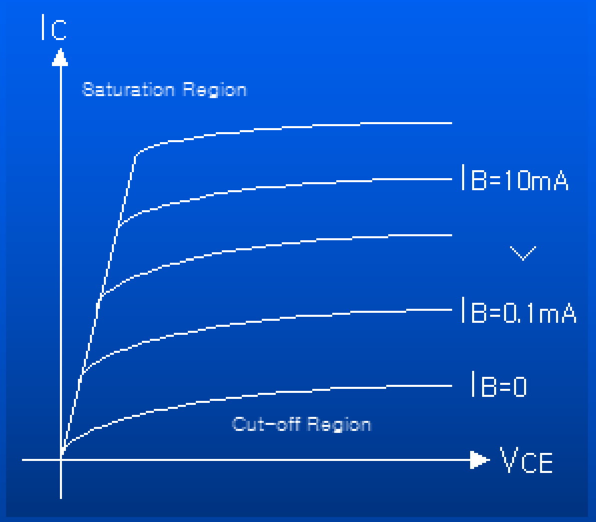
2-1. BJT(Bipolar Junction Transistor)



- ❑ 전류가 흐르지 못함
- ❑ 고전압의 경우는 Brake down 전류가 흐름

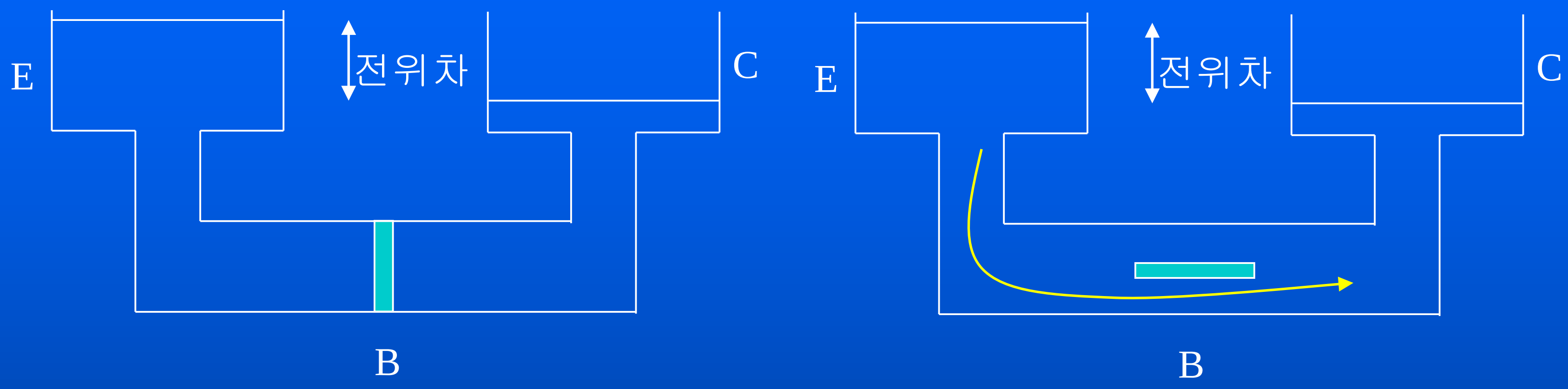
2-2. BJT의 동작원리: Bias 인가





- Base에 전류가 인가되면 Emitter로 +가 이동
- N에 +가 이동
- 전체적으로 전류가 흐름

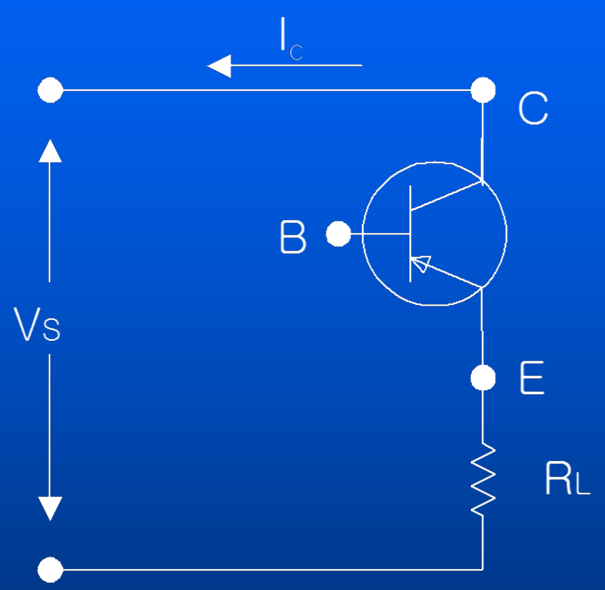
2-3. BJT의 동작원리: Bias의 역할



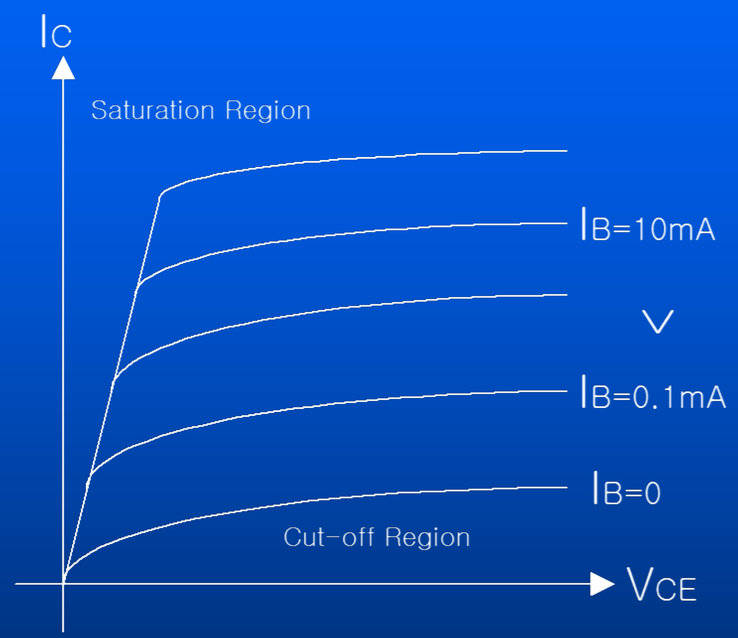
Base 전류	Base 위치	전류
미인가	닫힘	안흐름
인가	열림	흐름

❖ Base 의 전류에 따라 열리는 양이 달라짐

2-4. BJT의 동작원리: 특성곡선

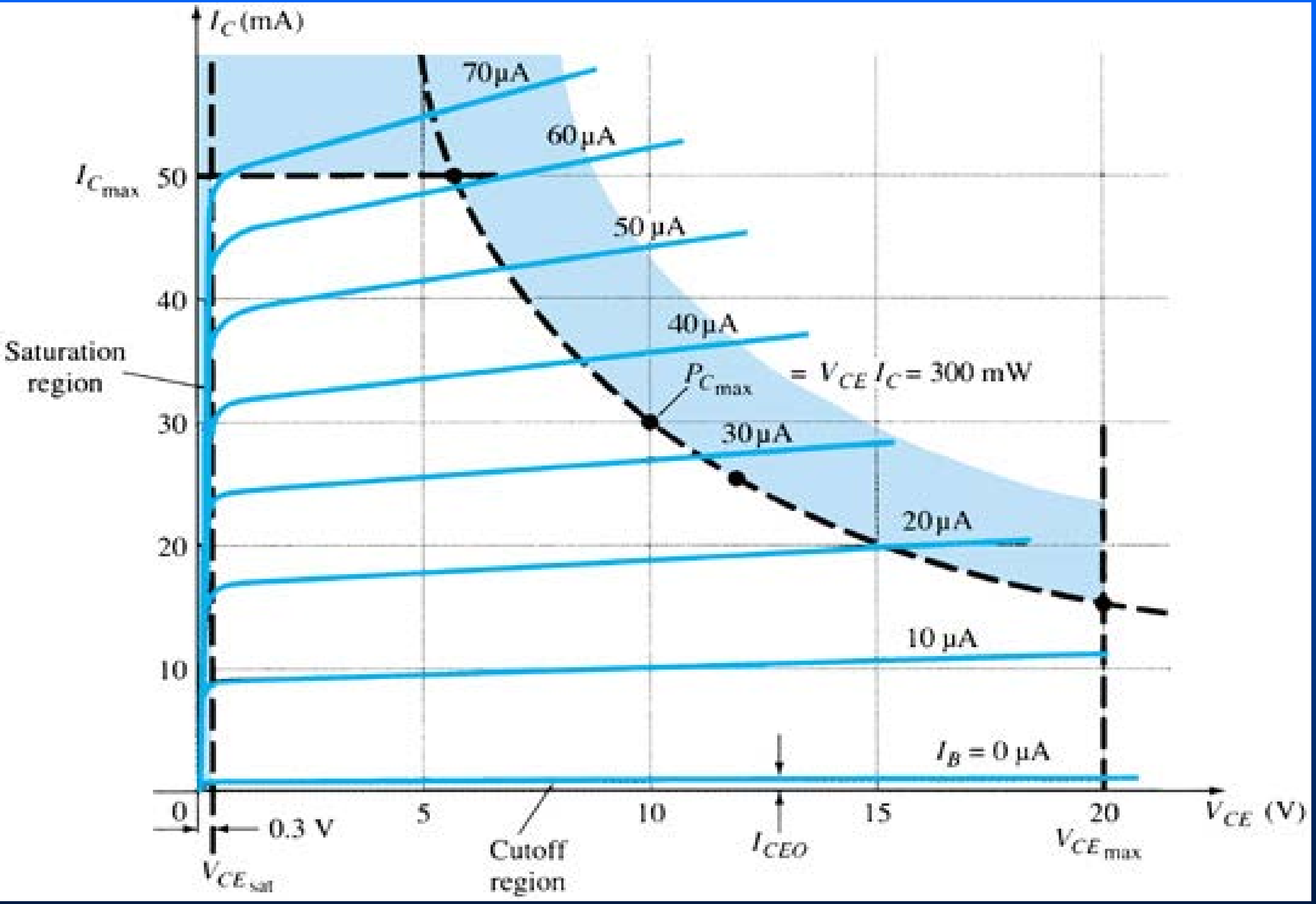


(a) circuit

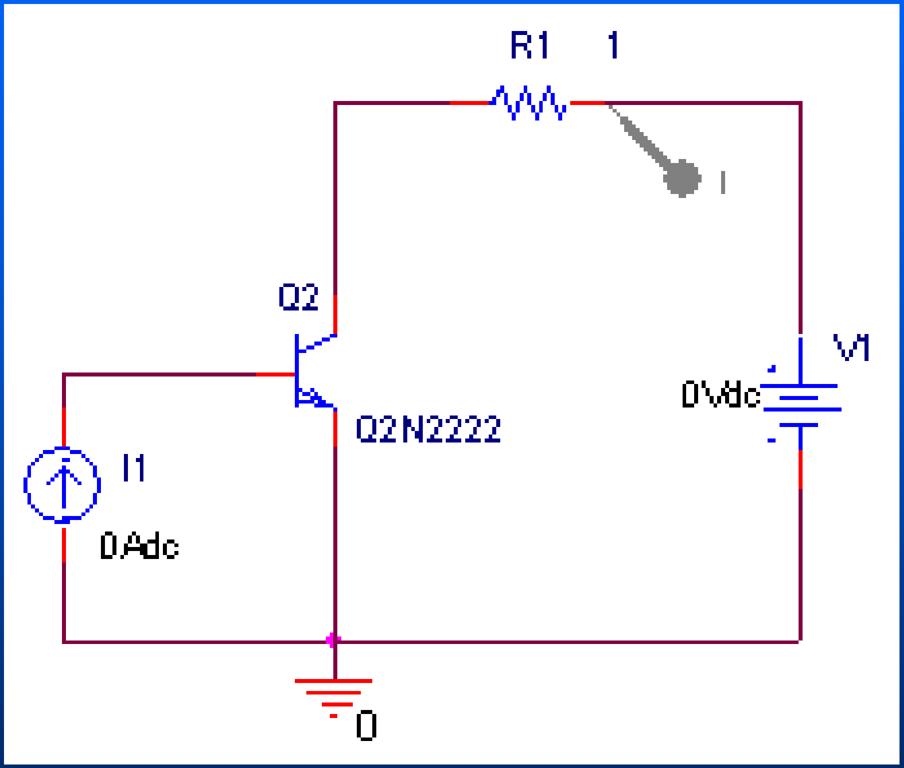


(b) V-I curve

2-7. BJT의 동작원리: V-I Curve



2-8. BJT의 특성 (OrCAD Simulation)

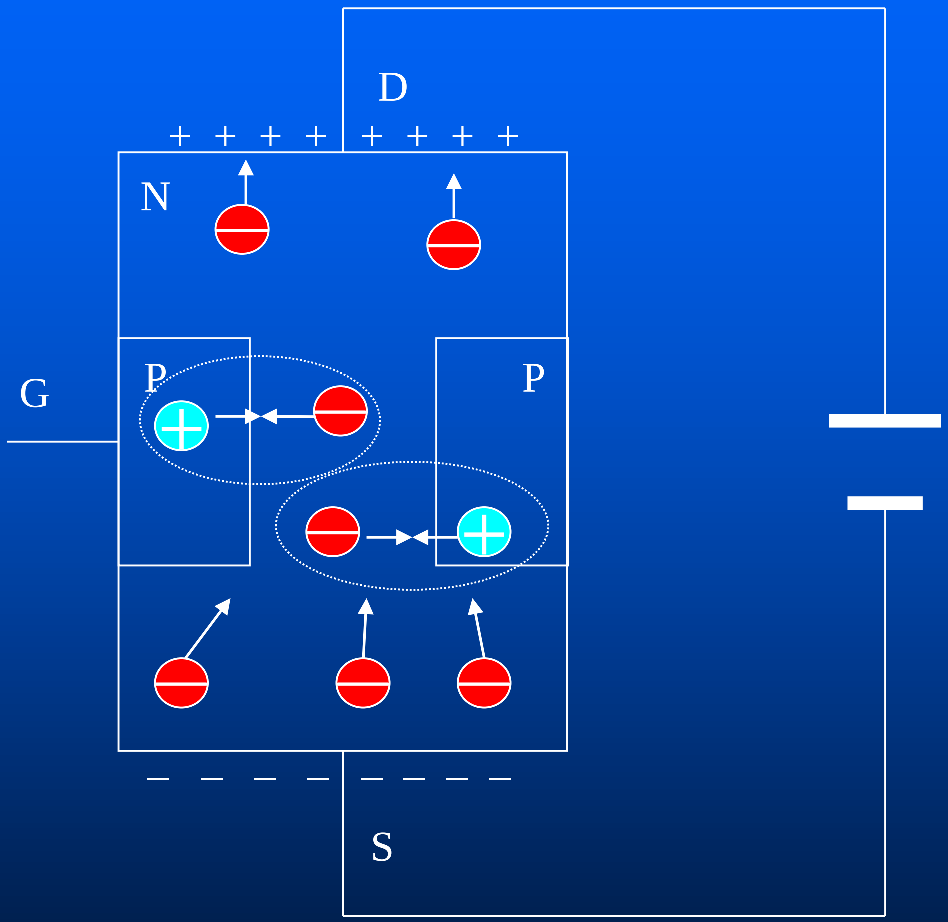


- *Parameter*
  - ✓ V_s*=0 V*
  - ✓ *Simulation*
  - ✓ *(DC Sweep)*

    0 0.1 6 V
  - ✓ *(Secondary Sweep)*

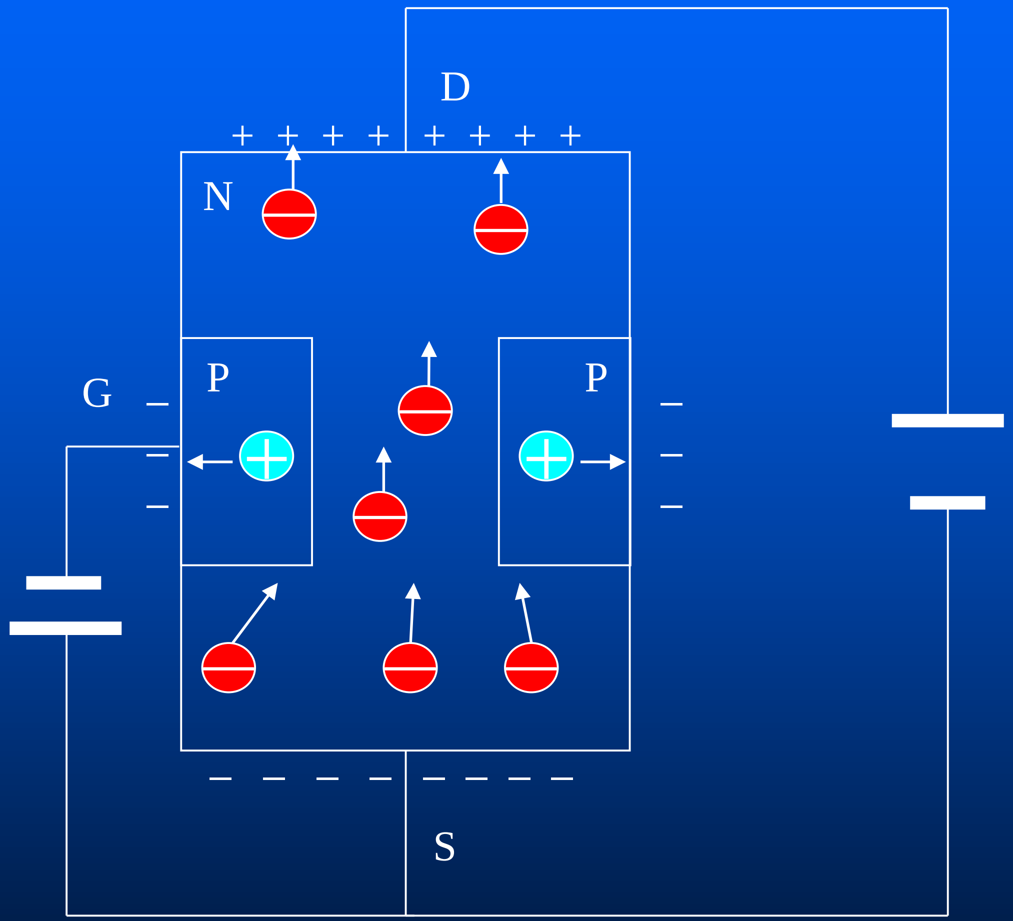
    0 1 m 5 mA

3-1. JFET의 동작 원리 : Bias 미인가



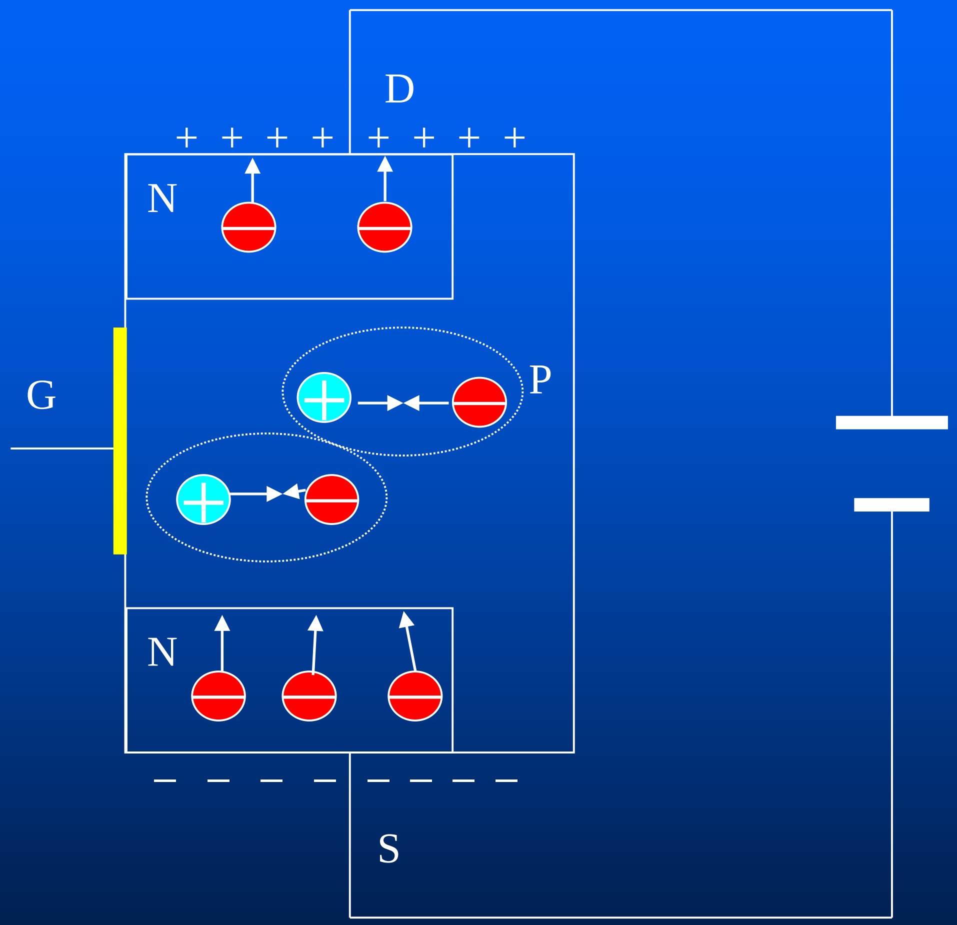
- GATE 에 전류가 인가되지 않으면
- Source 에서 -가 이동하여도
- Gate의 +와 중화되어
- 전체적으로 전류가 흐르지 못함

3-2. JFET의 동작 원리 : Bias 인가



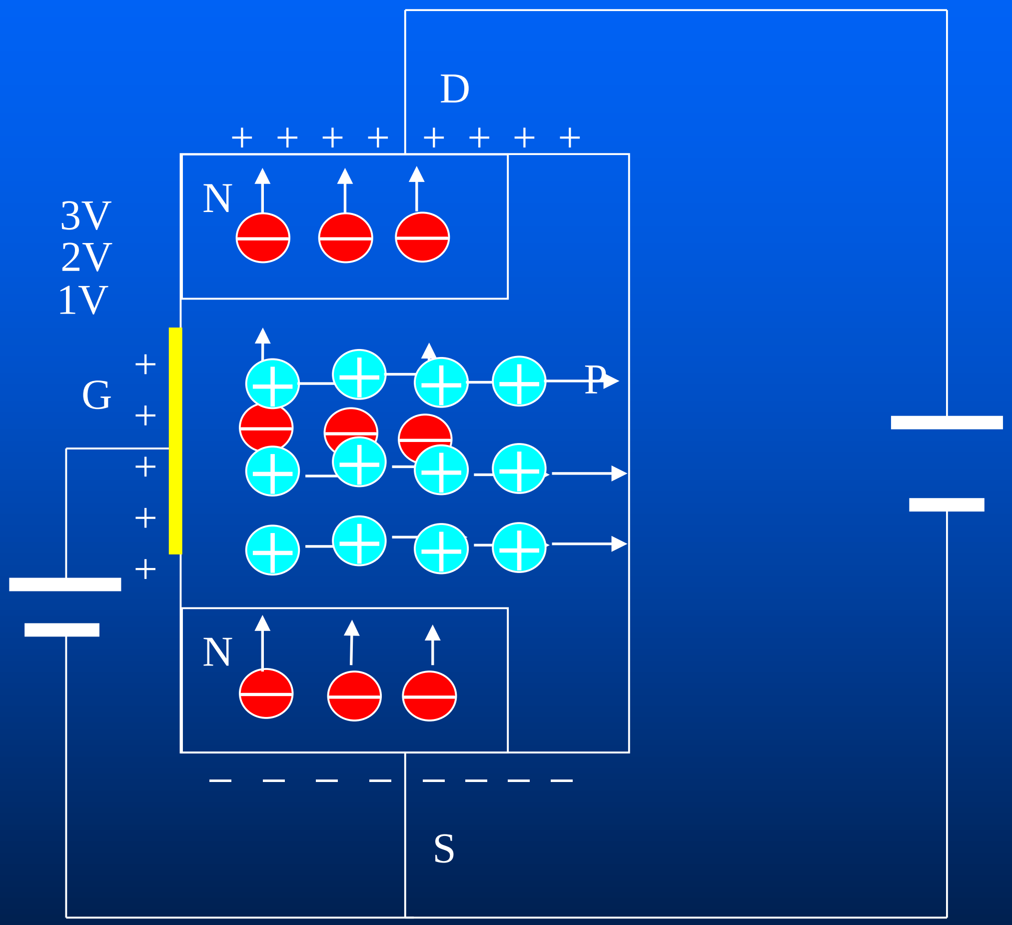
- GATE 에 전류가 인가되면
- Gate의 +가 –와 결합하여
- Source 에서 -가 이동하여전체적으로 전류가 흐름

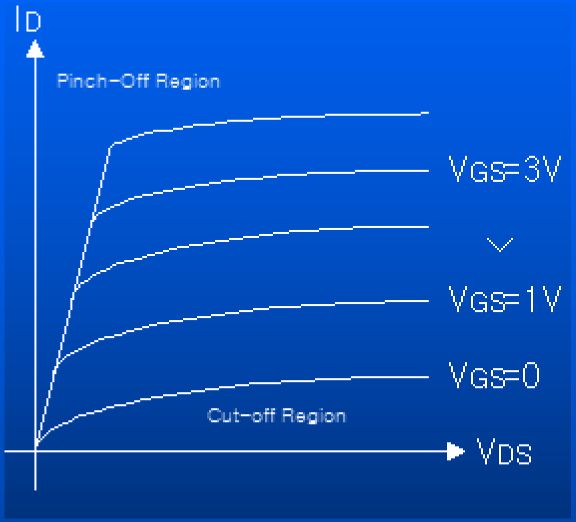
3-6. 증가형 MOSFET의 동작 원리 : Bias 미인가



- GATE 에 전류가 인가되지 않으면
- Source 에서 -가 이동하여도
- Gate의 +와 중화되어
- 전체적으로 전류가 흐르지 못함

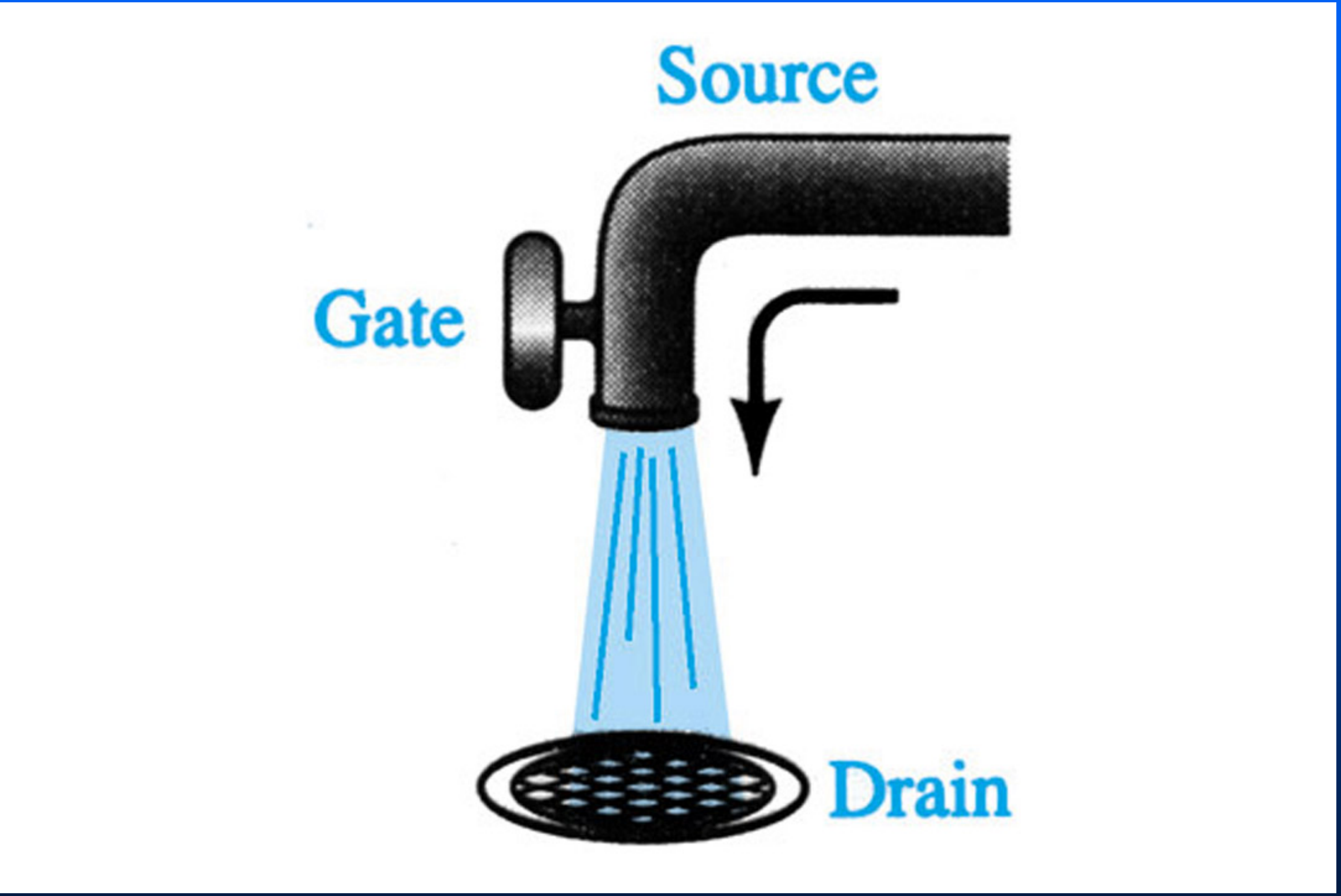
3-5. 증가형 MOSFET의 동작 원리 : Bias 미인가



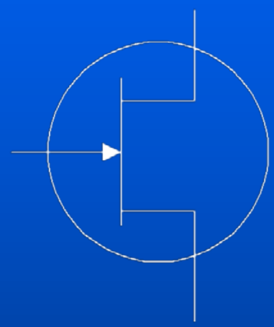
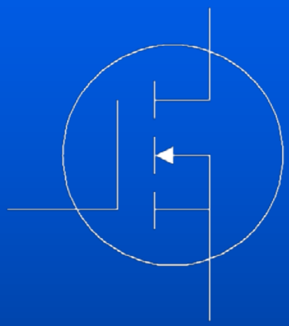
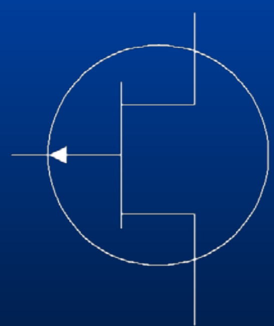
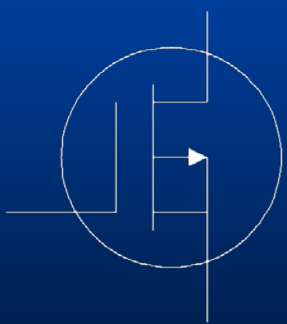
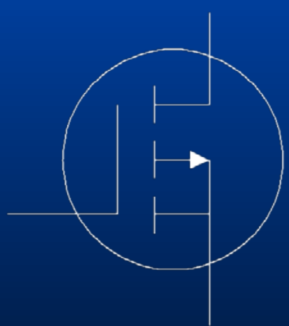


- GATE 에 전류가 인가되면
- Gate의 +가 –와 결합하여
- Source 에서 -가 이동하여전체적으로 전류가 흐름

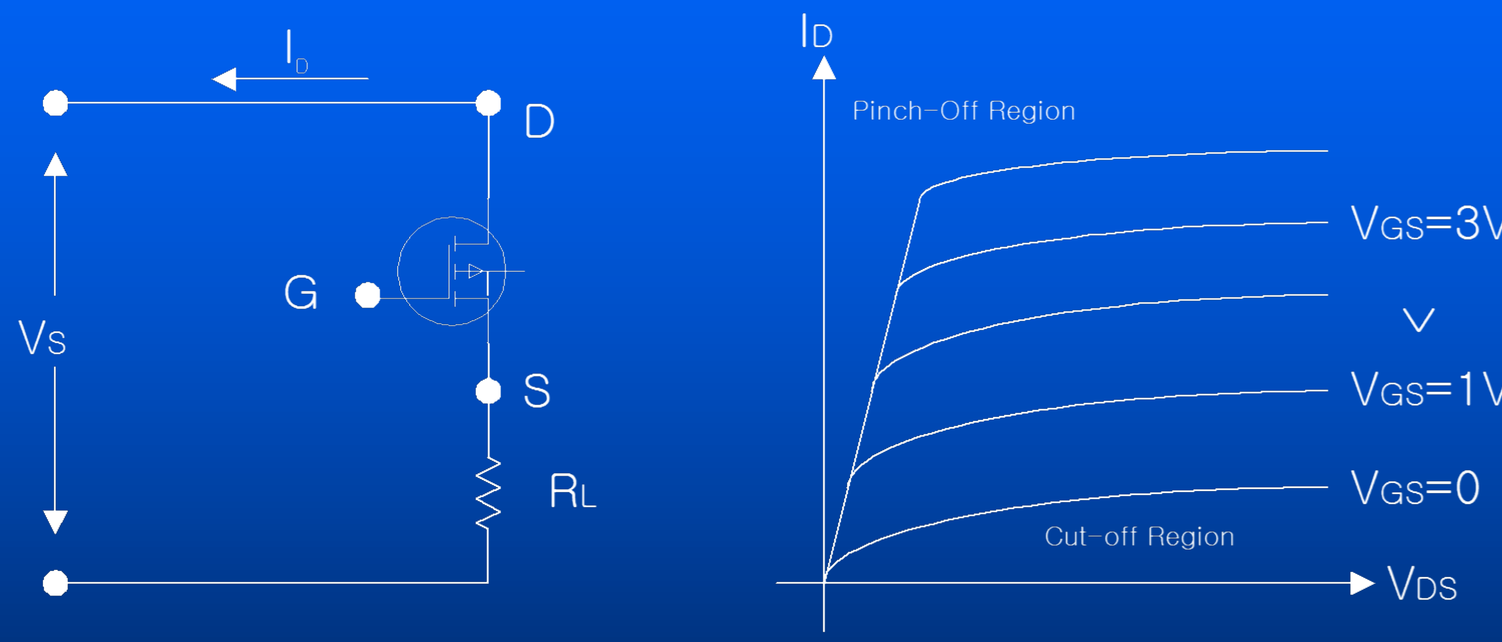
3-8. FET의 동작원리: Bias 원리



3-9. FET의 동작원리: Symbol

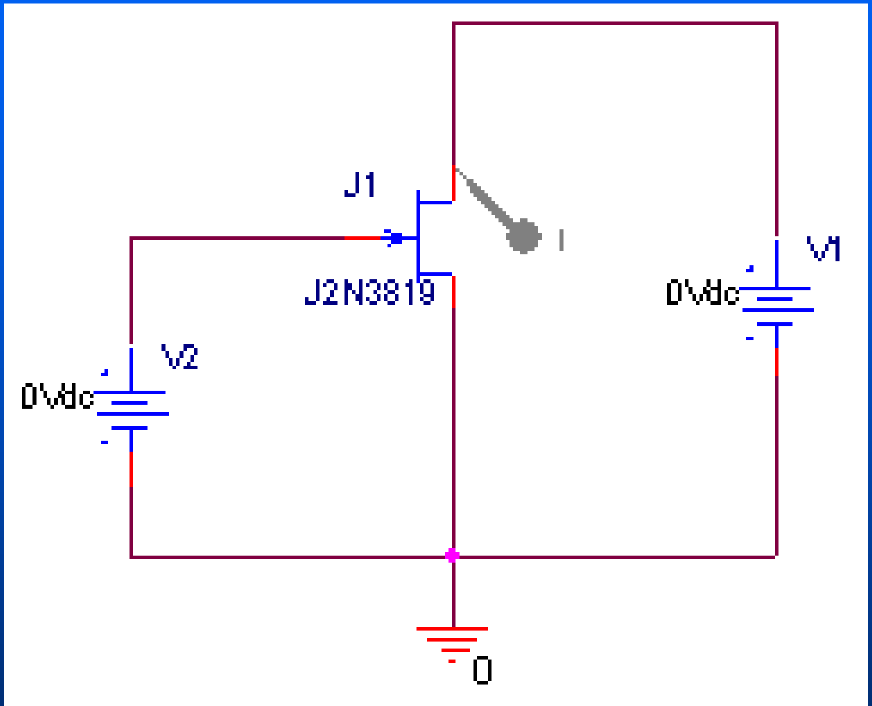
CHANNEL	JFET	공핍형 MOSFET	증가형 MOSFET
N			
P			

3-10. FET의 동작원리: 특성 곡선



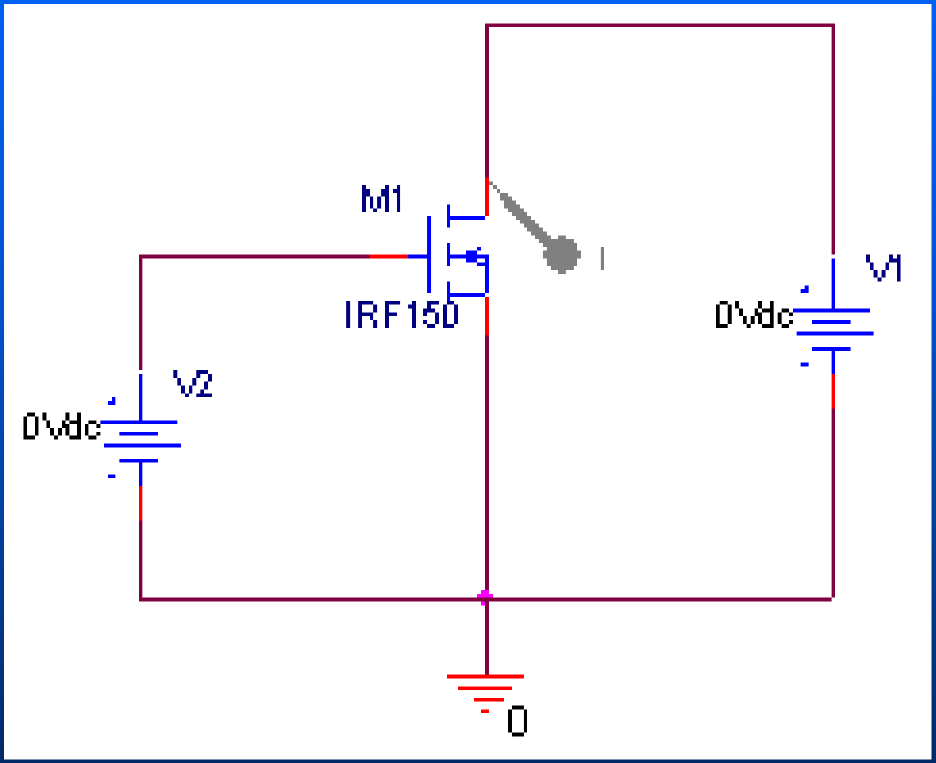
(a) circuit (b) V-I curve

3-11. JFET의 특성 (OrCAD Simulation)



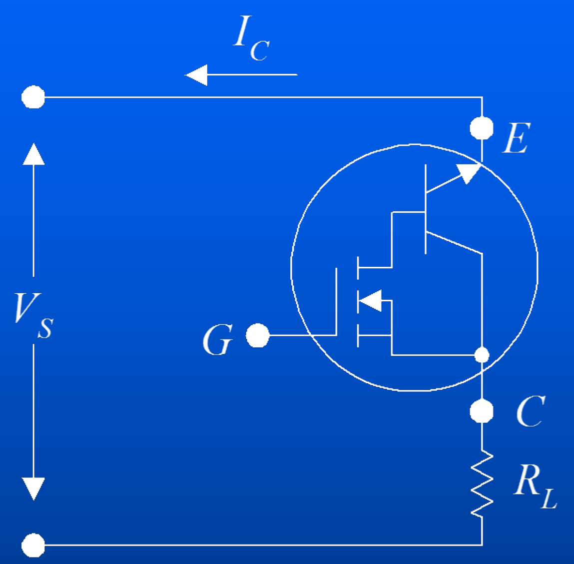
- *Parameter*
  - ✓ V_s=0 V
  - ✓ *Simulation*
  - ✓ *(DC Sweep)*
    0 0.1 15 V
  - ✓ *(Secondary Sweep)*
    0 1 -5 V

3-12. MOSFET의 특성 (OrCAD Simulation)

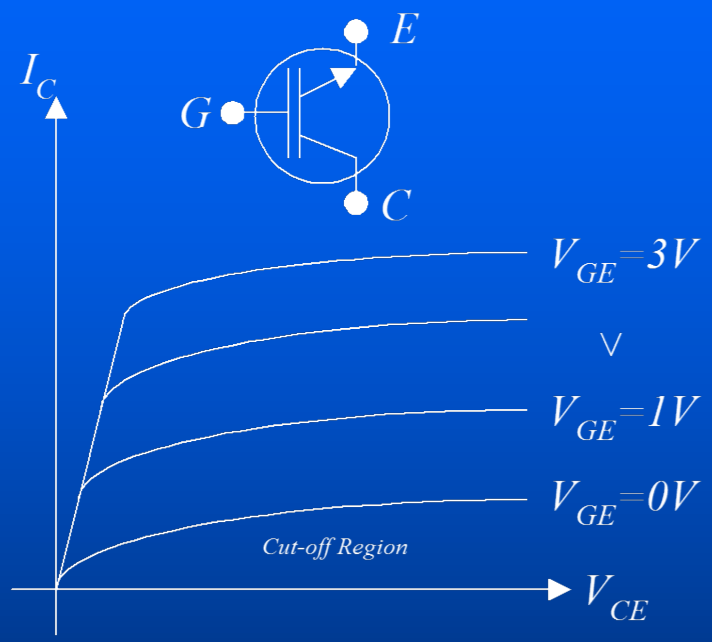


- *Parameter*
  - ✓ V_s=0 V
  - ✓ *Simulation*
  - ✓ *(DC Sweep)*
    0 0.1 10 V
  - ✓ *(Secondary Sweep)*
    0 1 5 V

4-1. IGBT(Insulated Gate Bipolar Transistor)



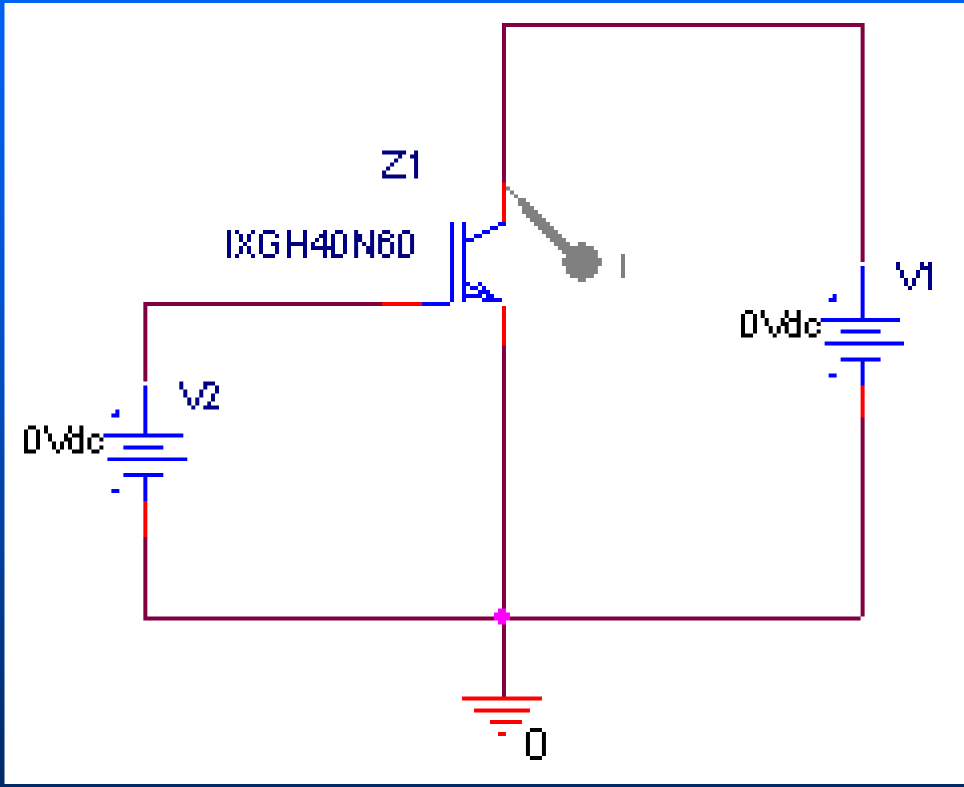
(a) circuit



(b) V-I curve

- FET와 BJT의 장점을 이용
- 전압으로 컨트롤, 큰전류 인가 가능

4-2. IGBT의 특성 (OrCAD Simulation)



- *Parameter*
  - ✓ V_s=0 V
  - ✓ *Simulation*
  - ✓ *(DC Sweep)*

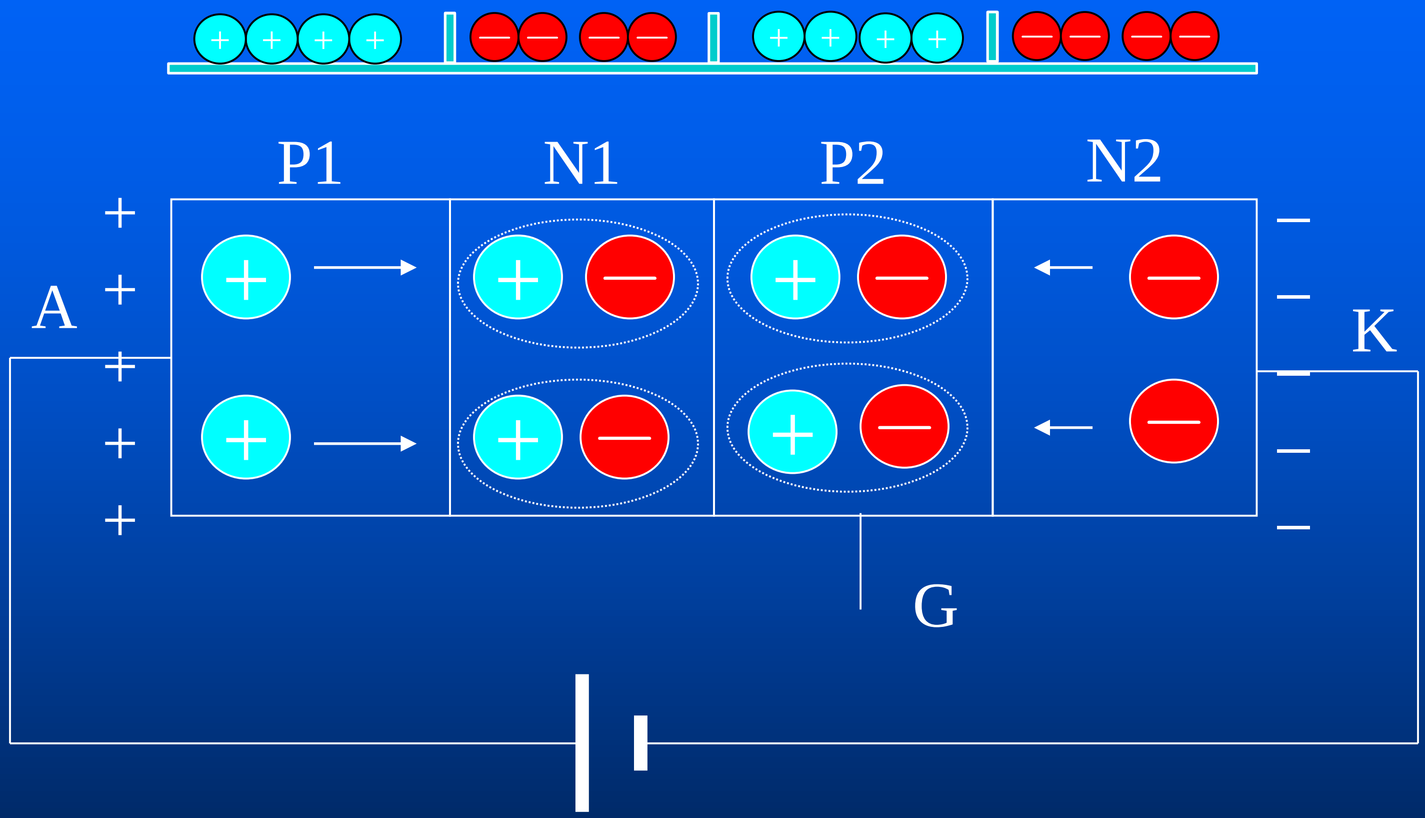
    0 1 50 V
  - ✓ *(Secondary Sweep)*

    0, 5, 7 V

4-2. Transistor 특성

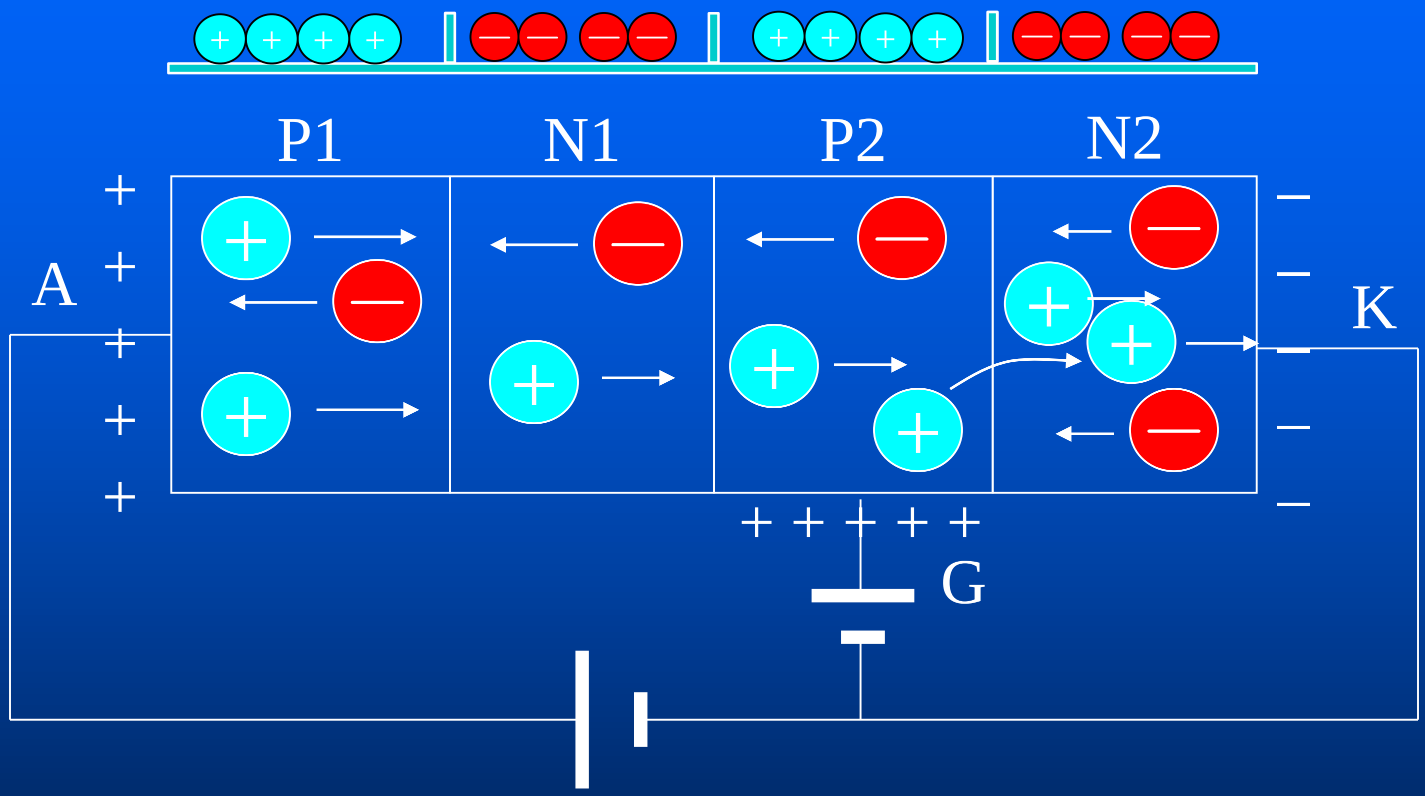
	BJT	FET	IGBT
구동방식	전류	전압	전압
인가전류	크다	작다	크다
단가	저가	고가	중간

5-1. SCR(Silicon Controlled Rectifier)



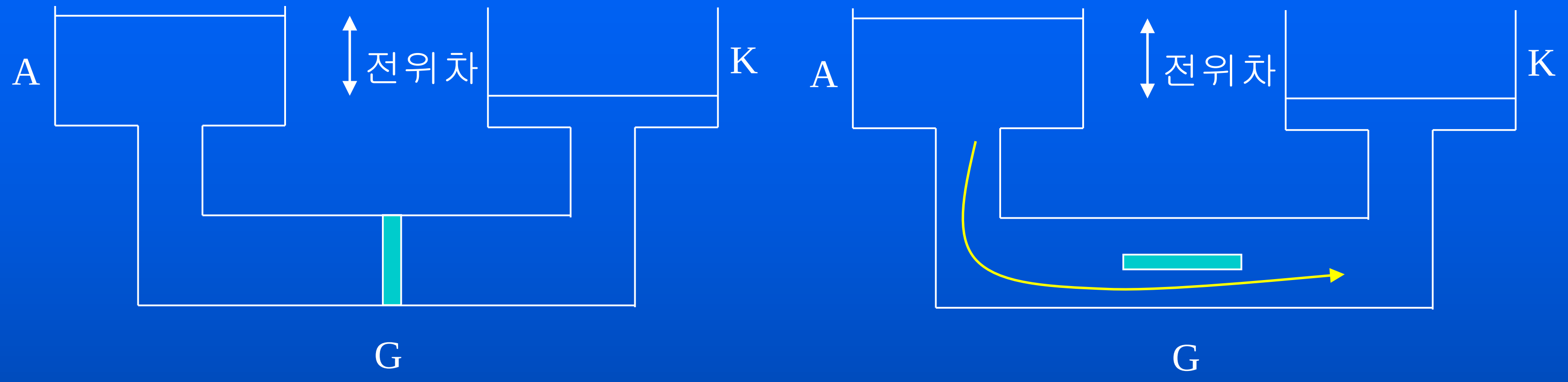
- Anode, Cathode에만 전압을 인가
- N1, P2에서 전자와 정공이 결합 중성화
- 전류가 흐르지 못함

5-2. SCR의 동작원리: Bias 인가



- Gate에 전압이 인가되면 Cathode로 +가 이동
- 빈 부분이 –가 되어 N1의 +가 이동
- 전체적으로 전류가 흐름

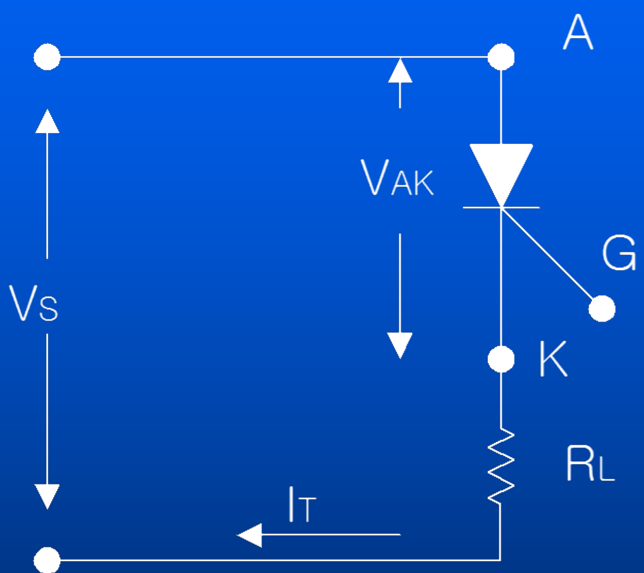
5-3. SCR의 동작원리: Bias 원리



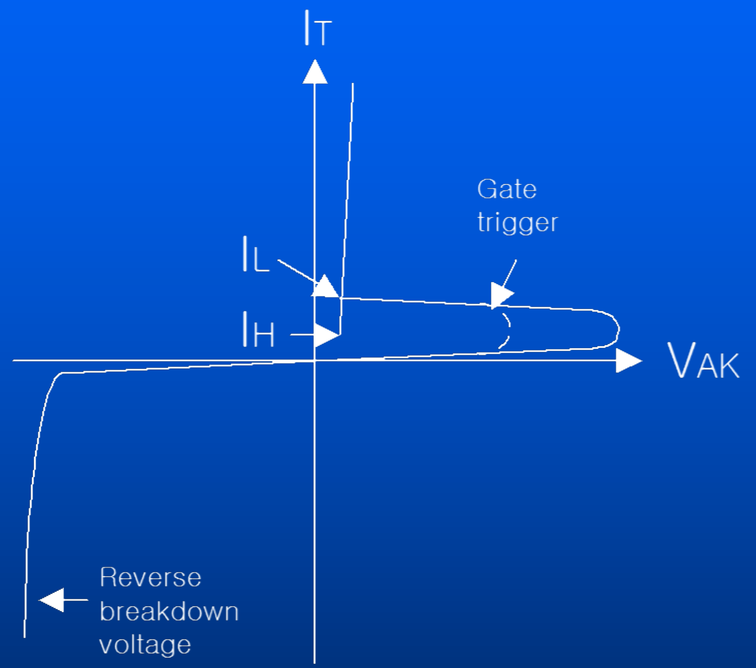
Gate 전압	Gate 위치	전류
미인가	닫힘	안흐름
인가	열림	흐름

❖ Gate의 전류에 따라 열리는 양이 달라짐

5-4. SCR의 동작원리: 특성곡선

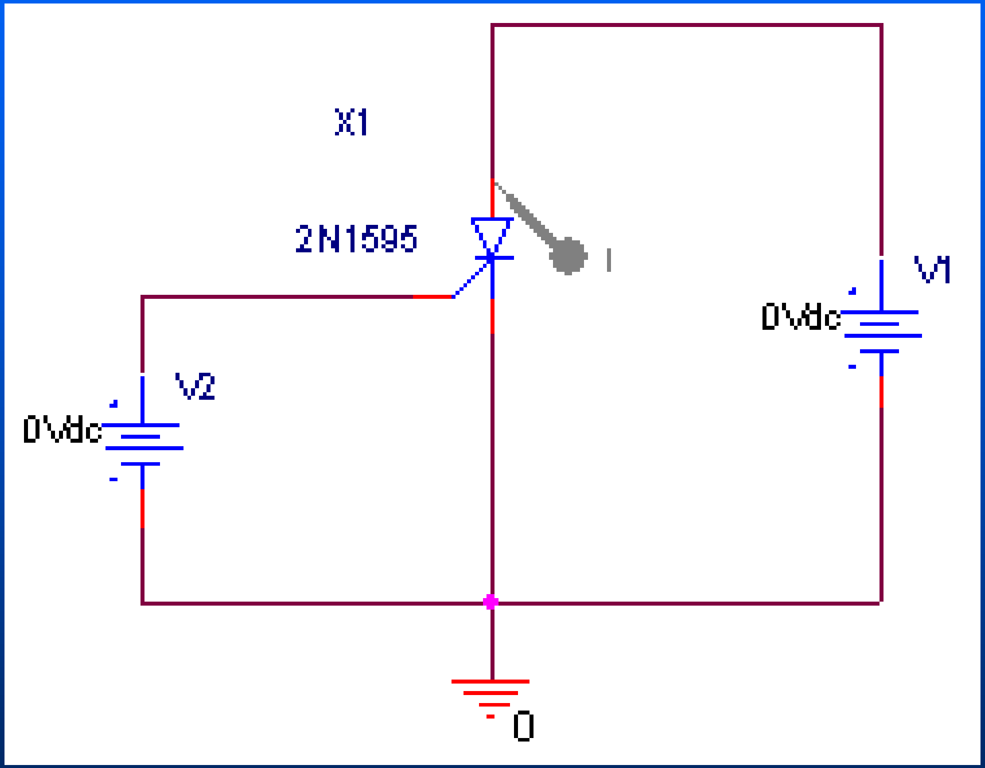


(a) circuit



(b) V–I curve

5-5. SCR의 특성 (OrCAD Simulation)



- *Parameter*
  - ✓ V_s=0 V
  - ✓ *Simulation*
  - ✓ *(DC Sweep)*
    0 1 50 V
  - ✓ *(Secondary Sweep)*
    0 0.2 0.8 V