1. Source

Independent

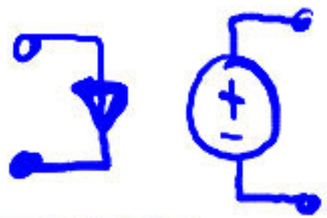
(Voltage constant)

Current constant

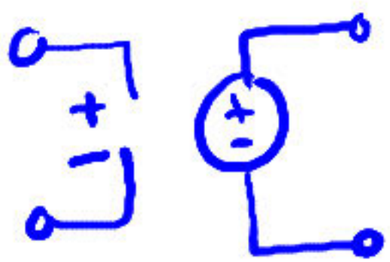
Dependent

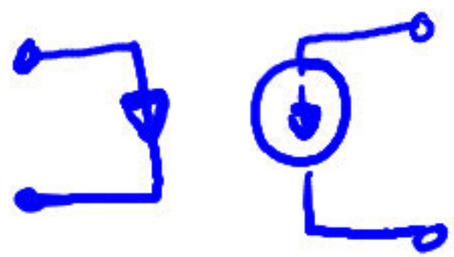
Variable Voltage

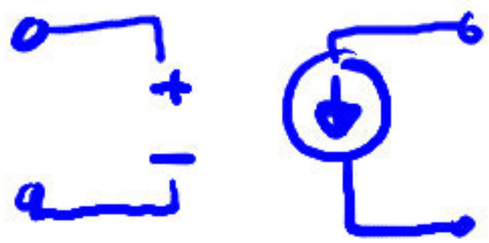
Variable Current

Dependent { 4.  CCVS Current controlled ~~Current~~ Source Voltage Source

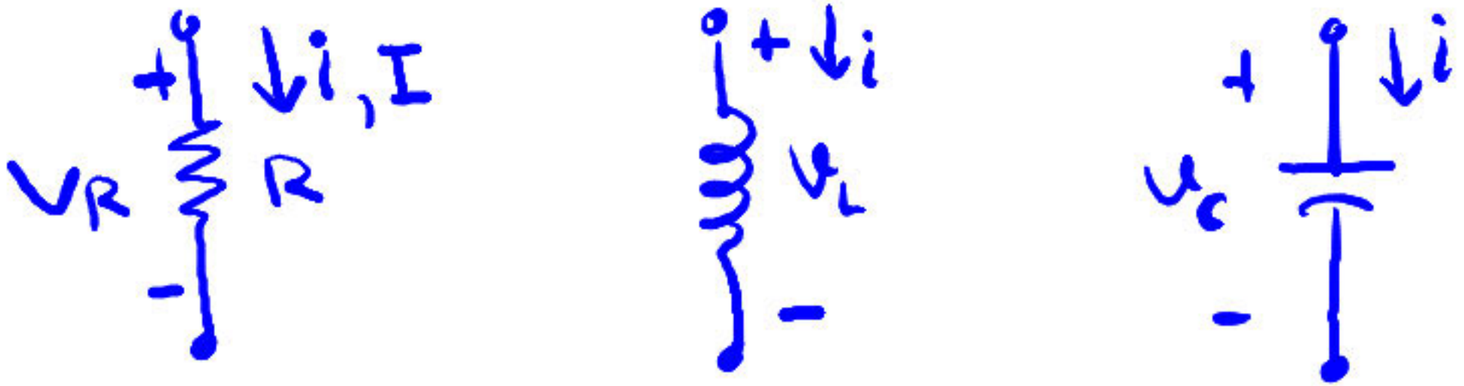
1. Voltage Controlled Voltage Source

 (VCVS)

2.  Current Controlled Current Source (CCCS)

3.  Voltage Controlled current Source (VCCS)

Circuit Element (passive)

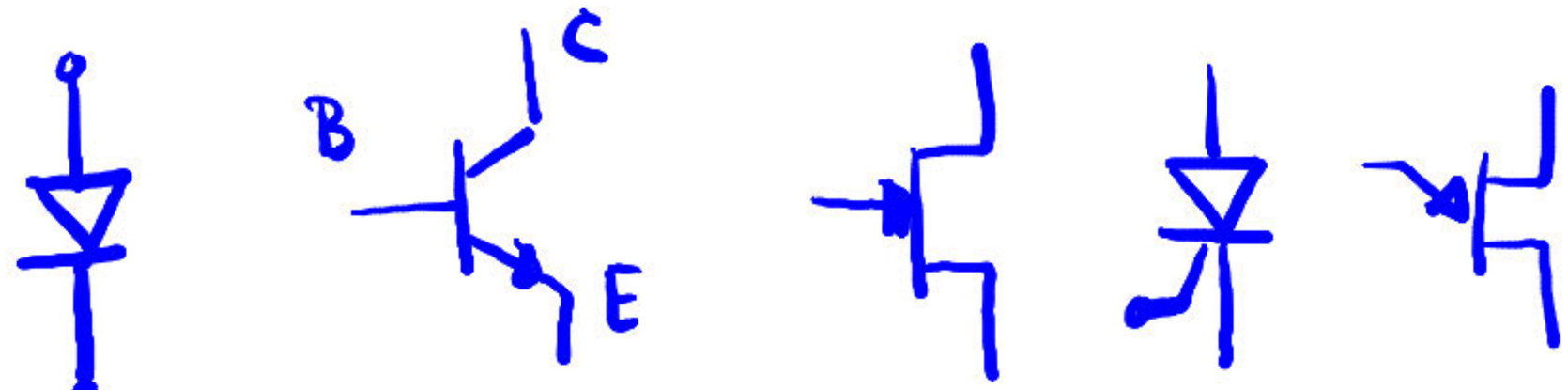


$$R = \frac{v_R}{I} \qquad R = \frac{v_R}{i}$$

$$v_L = L\frac{di}{dt}$$

$$v_c = \frac{1}{C}\int i\,dt$$

Circuit Element (Active)

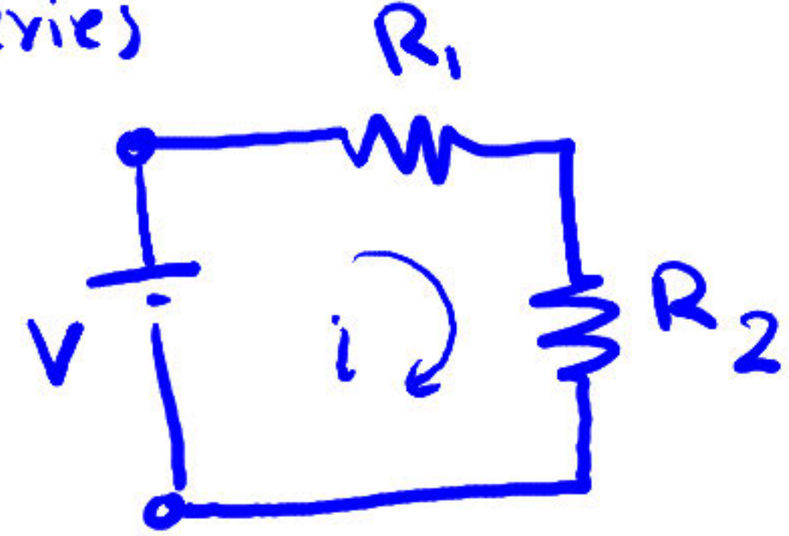


Diode Transistor FET SCR UJT

Circuit element Combination

- Series Resistor
- Parallel Resistor
- Mix Resistor
- Complex (Δ-Y)

1. Series

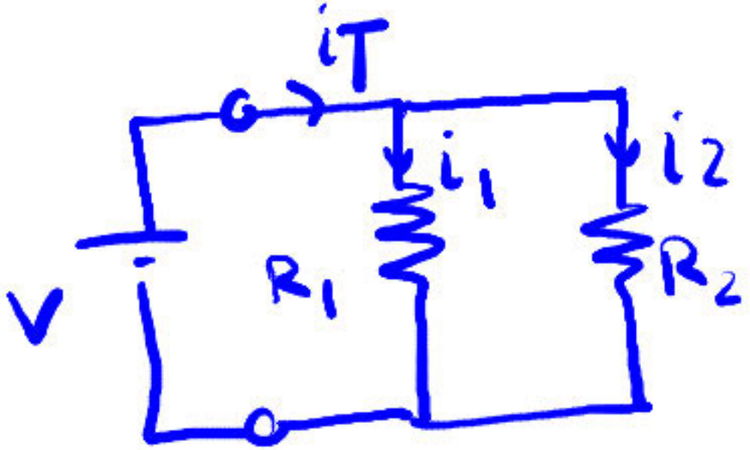


$$i_{R_1} = i_{R_2} = i$$

$$V_{R_1} + V_{R_2} = V$$

$$R_1 + R_2 = R_T$$

2. Parallel.

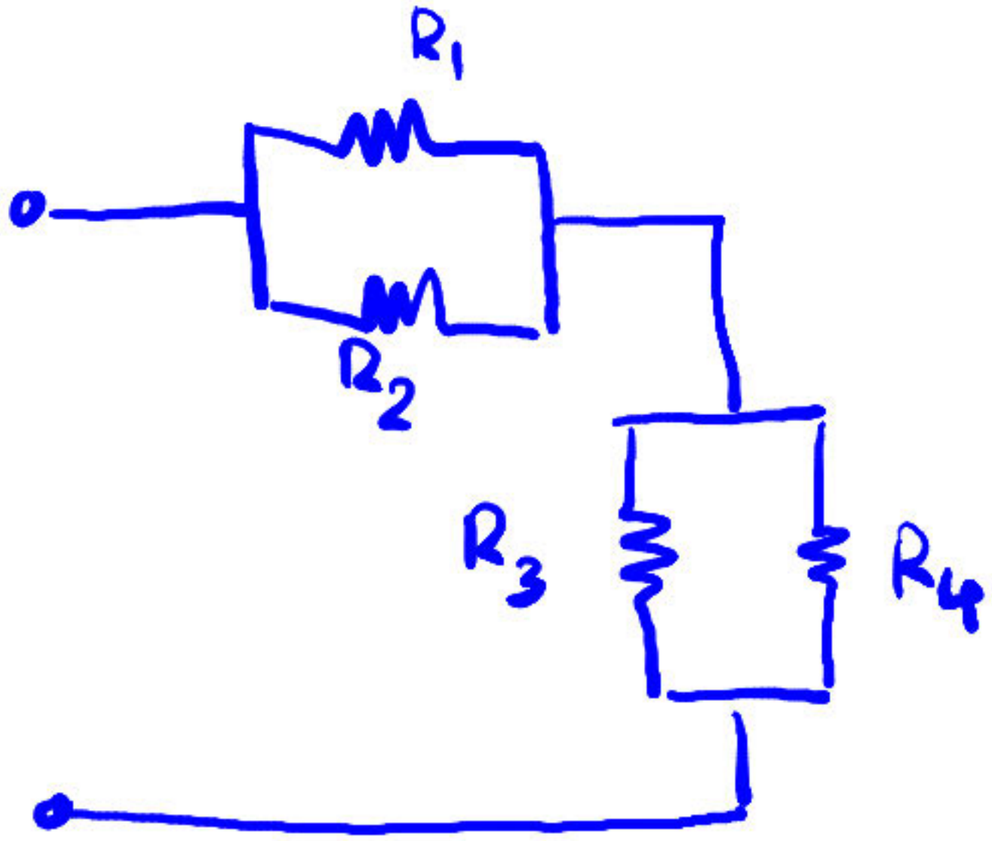


$$i_T = i_1 + i_2$$

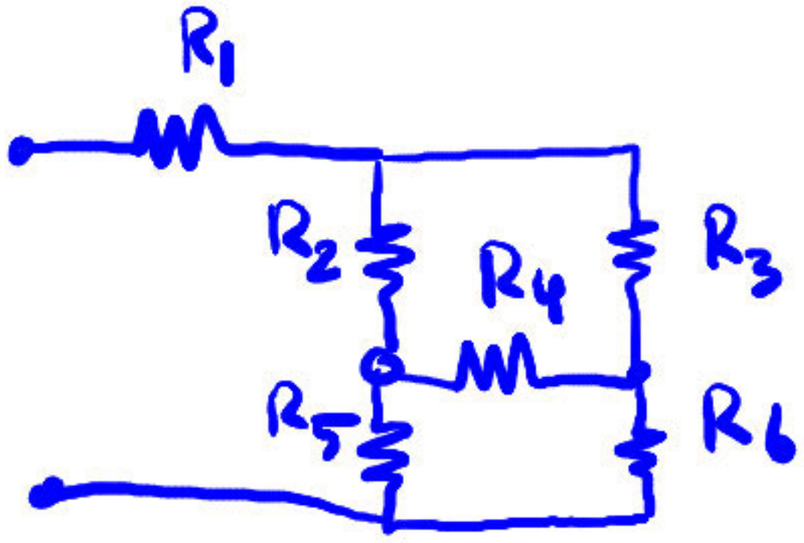
$$V = V_{R_1} = V_{R_2}$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_1 \times R_2}{R_1 + R_2}$$

3. Mix

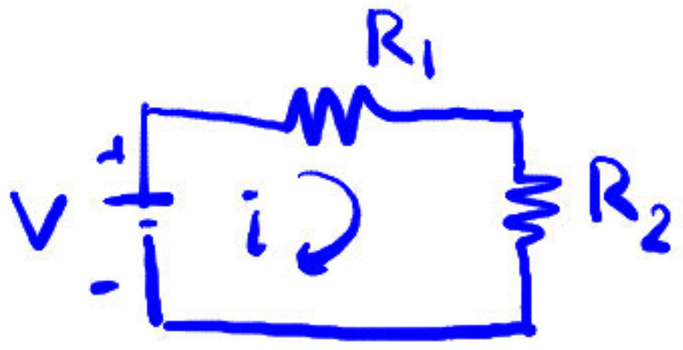


4.



Δ - Y

- Voltage Divider



Ohm's Law

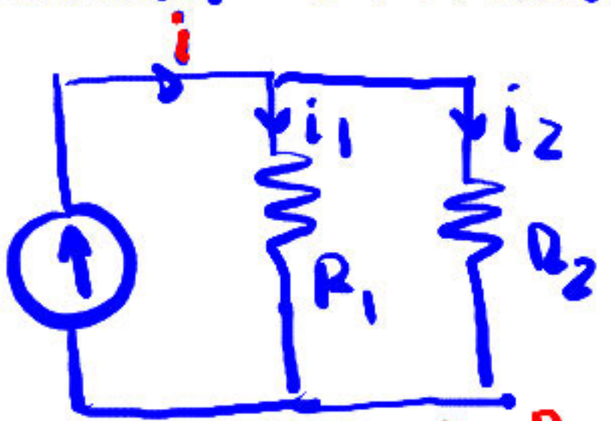
$$I = \frac{V}{R_1 + R_2}$$

$$V_{R_1} = R_1 \cdot I$$

$$V_{R_1} = \frac{R_1}{R_1 + R_2} \cdot V$$

$$V_{R_2} = \frac{R_2}{R_1 + R_2} \cdot V$$

- Current Divider



$$R = \frac{R_1 R_2}{R_1 + R_2}$$

Ohm's Law

$$I = \frac{V}{R_1} + \frac{V}{R_2}$$

✔

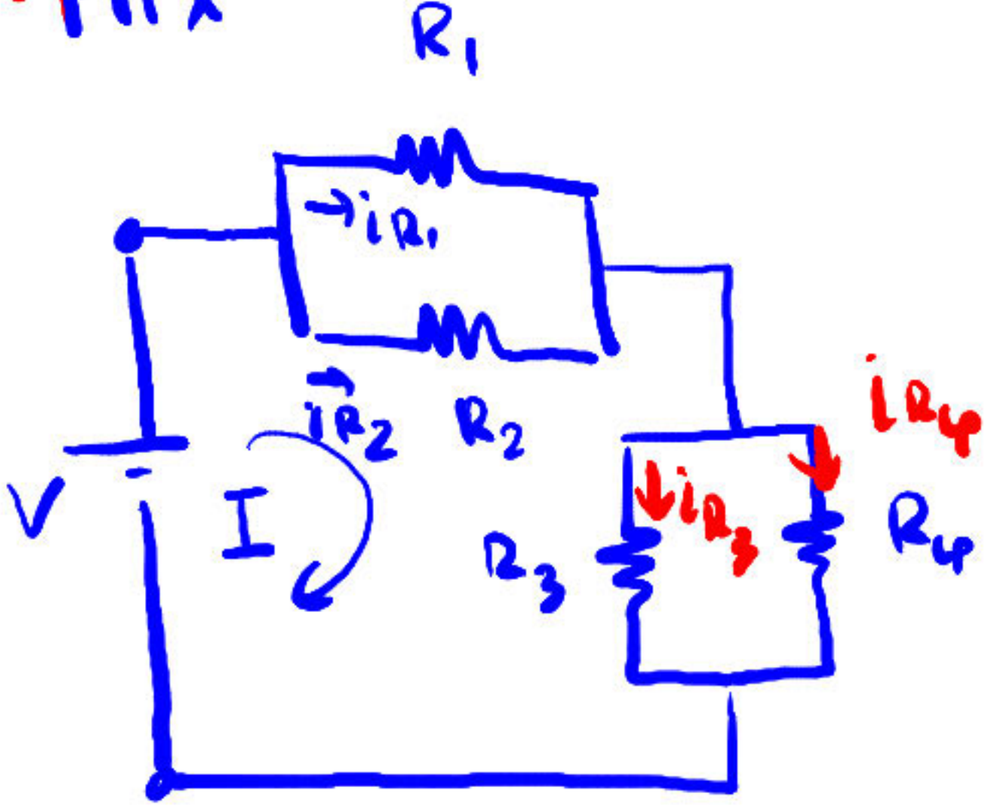
$$I = \frac{R_1 + R_2}{R_1 \times R_2} \cdot V$$

Voltage Divider

$$I_{R_1} = \frac{V}{R_1} = \frac{R_2}{R_1 + R_2} \cdot I$$

$$I_{R_2} = \frac{V}{R_2} = \frac{R_1}{R_1 + R_2} I$$

- Mix



$$R_{12} = \frac{R_1 R_2}{R_1 + R_2}, \quad R_{34} = \frac{R_3 R_4}{R_3 + R_4}$$

$$R = R_{12} + R_{34} \rightarrow I = \frac{V}{R}$$

- Voltage Divider

$$V_{R_{12}} = \frac{R_{12}}{R_{12} + R_{34}} \cdot V$$

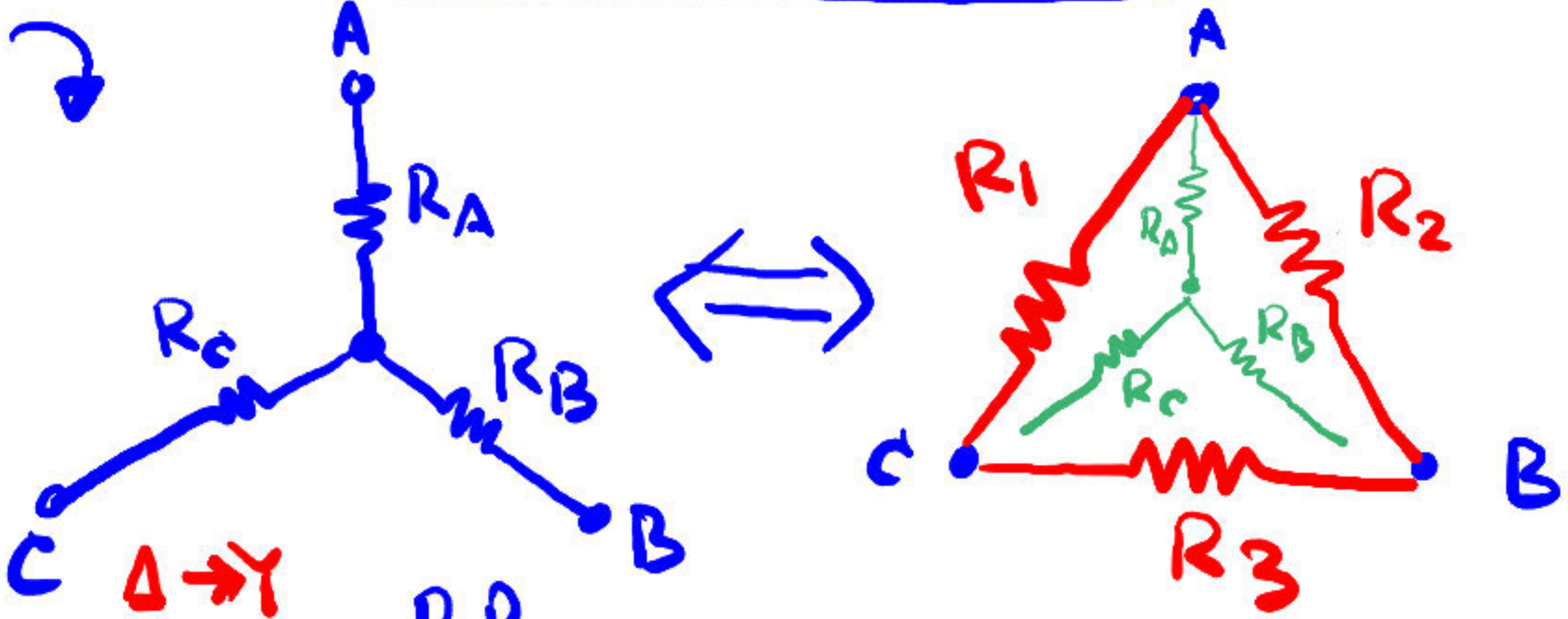
$$V_{R_{34}} = \frac{R_{34}}{R_{12} + R_{34}} \cdot V$$

Ohm's Law

$$I_{R_1} = \frac{V_{R_{12}}}{R_1}, \quad I_{R_2} = \frac{V_{R_{12}}}{R_2}$$

$$I_{R_3} = \frac{V_{R_{34}}}{R_3}, \quad I_{R_4} = \frac{V_{R_{34}}}{R_4}$$

Star - Delta Transformation



$\Delta \rightarrow Y$

$$R_A = \frac{R_1 R_2}{R_1+R_2+R_3}, \quad R_B = \frac{R_2 R_3}{R_1+R_2+R_3}, \quad R_C = \frac{R_1 R_3}{R_1+R_2+R_3}$$

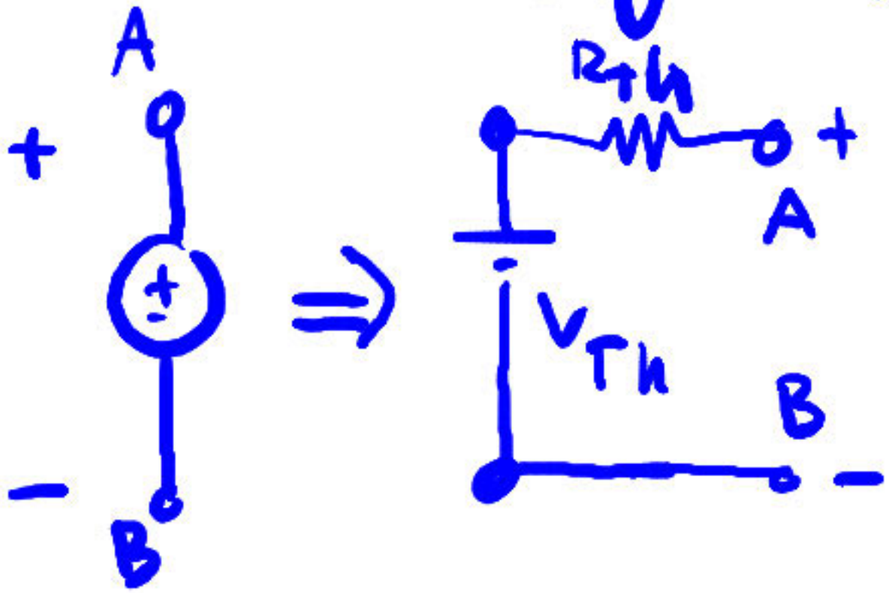
$Y \rightarrow \Delta$

$$R_1 = \frac{R_A R_B + R_B R_C + R_A R_C}{R_B}, \quad R_2 = \frac{''}{R_C}, \quad R_3 = \frac{''}{R_A}$$

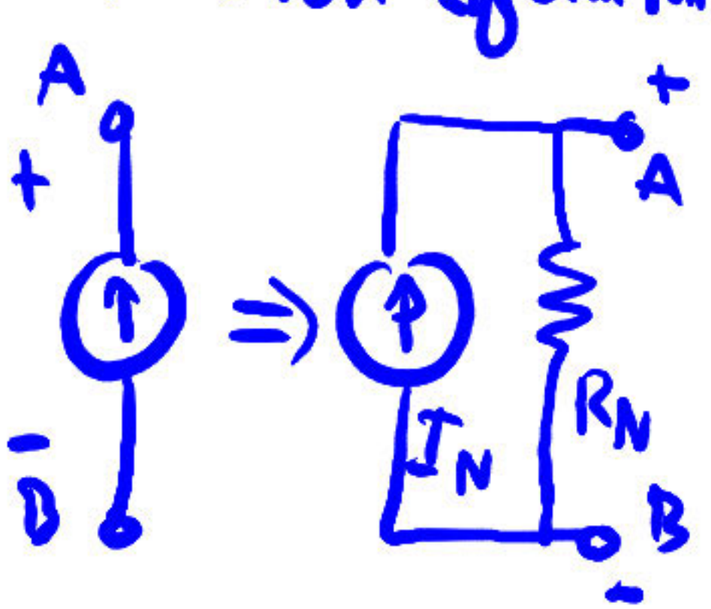
Source Transformation

$\begin{cases} R_{Th} = R_N \end{cases}$

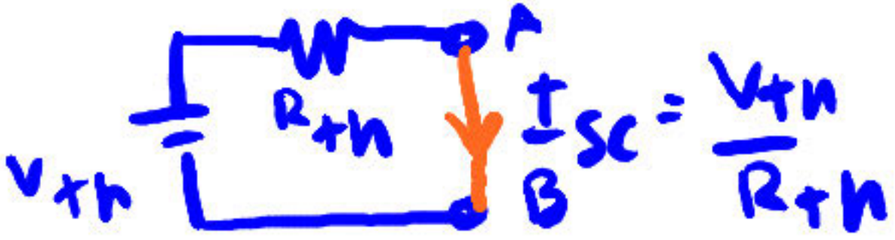
- Thevinin Equivalent



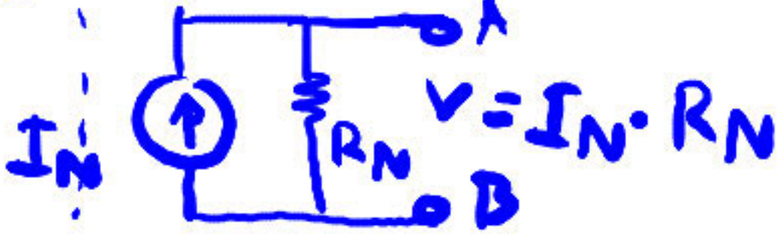
- Norton Equivalent



- Short Circuit Current

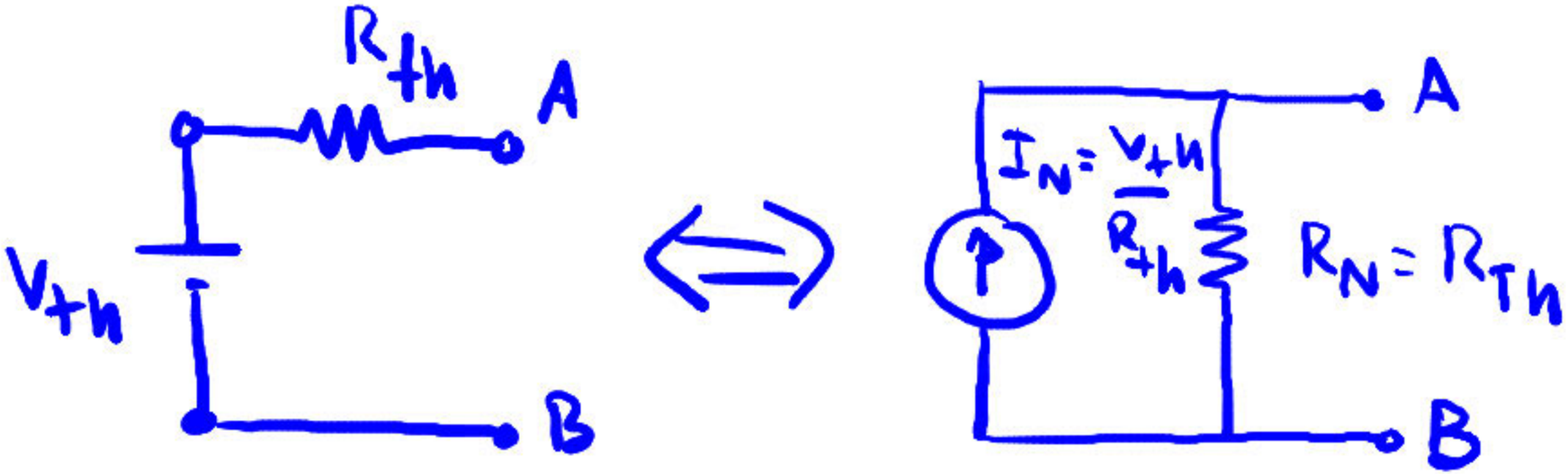


- Open Circuit Voltage

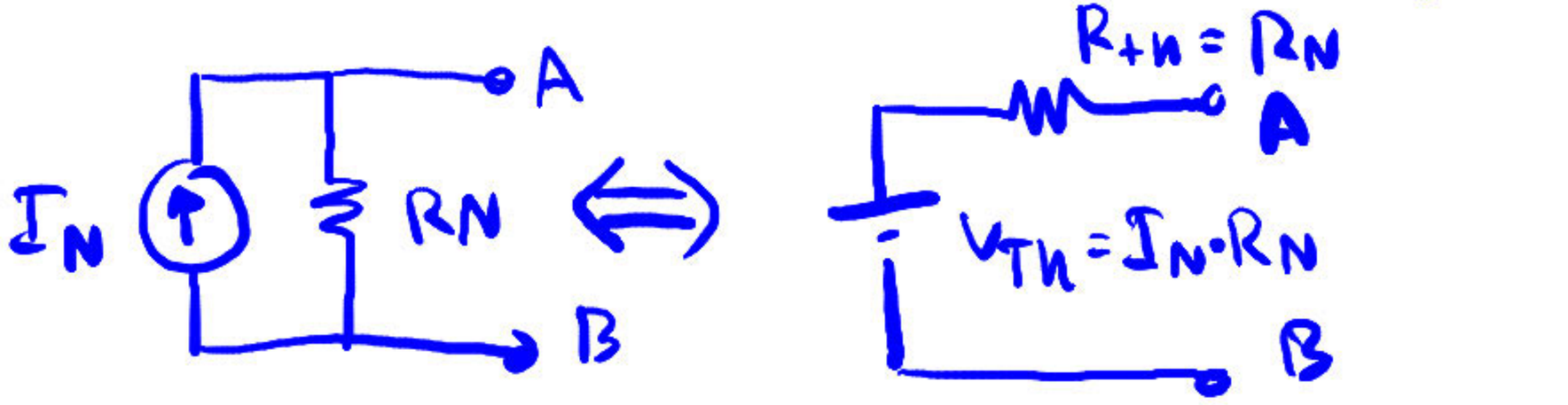


SI

- Thevinin to Norton Transformation



- Norton to Thevinin Transformation



S^{-1} , $f = \frac{1}{T}$ =

$10^{6}, 10^{3}, 10^{-2}, 10^{-3}, 10^{-6}, 10^{-9}, 10^{-12}$

Ex

1. $500{,}000\ \Omega = \frac{500000}{10^{3}}\ K\Omega = 500\ K\Omega$

2. $= \frac{500{,}000}{10^{6}}\ M\Omega = 0.5\ M\Omega$

3. $0.0001\ A = \frac{0.0001}{10^{-3}}\ mA = 0.1\ mA$

$= \frac{}{10^{-6}}\ \mu A = 100\ \mu A$

- 1130 Ω Standar 1.13 kΩ
- 3,500,000,000 bit = 3.5 Gbit
- 13,560,000 H_2 = 13.56 MH_2
- 0.039 nA = 39 pA
- 1.173×10^{-5} μA = 11.73 pA