Superposition

If a circuit is linear,

Choose $\vec{u}_1 = \begin{bmatrix} u \\ 0 \\ 0 \\ \vdots \end{bmatrix} \rightarrow \vec{y}_1$ Output due to u alone

Choose $\vec{u}_2 = \begin{bmatrix} 0 \\ v \\ 0 \\ 0 \\ \vdots \end{bmatrix} \rightarrow \vec{y}_2$ Output due to v alone

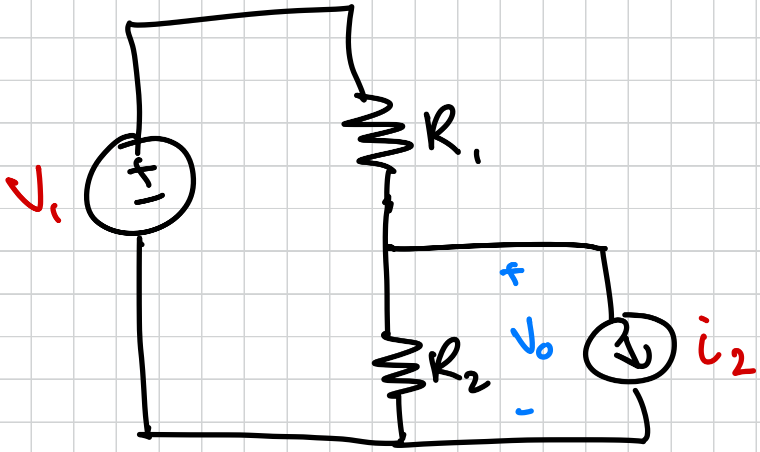
$\vdots$

Choose $a, b = 1$

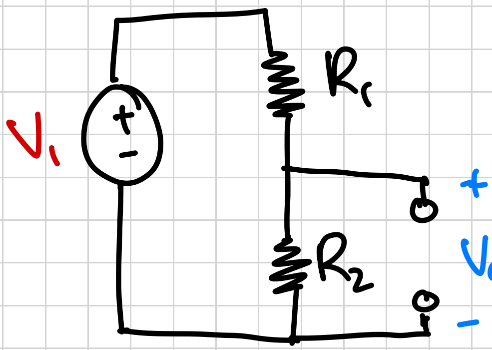
$$\underbrace{\vec{y}}_{\text{True Output}} = 1 \times \underbrace{\vec{y}_1}_{\text{Output due to u alone}} + 1 \times \underbrace{\vec{y}_2}_{\text{Output due to v alone}} + \cdots$$

Inputs

Outputs

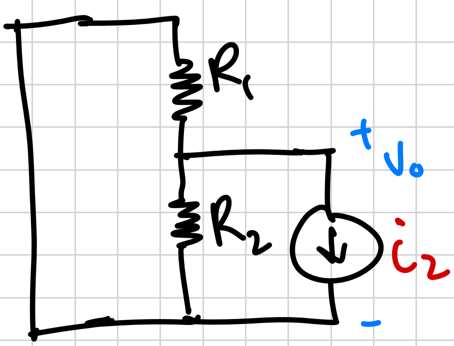


Apply voltage source alone



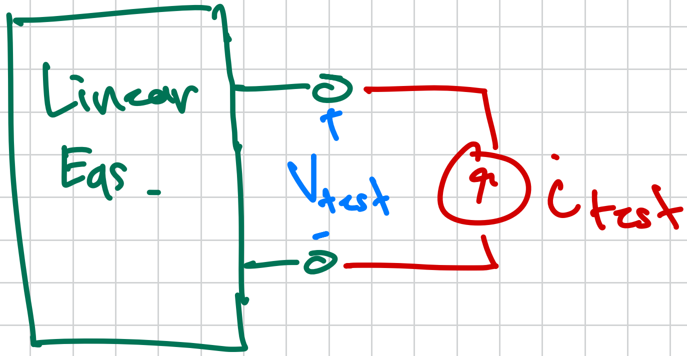
$$V_o = \underbrace{\frac{R_2}{R_1+R_2} V_1}_{\text{Output due to } V_1 \text{ alone}}$$

Apply current source alone



$$V_o = \underbrace{-\frac{R_1 R_2}{R_1+R_2} i_2}_{\text{Output due to } i_2 \text{ alone}}$$

$$V_o = \frac{R_2}{R_1+R_2} V_1 - \frac{R_1 R_2}{R_1+R_2} i_2$$

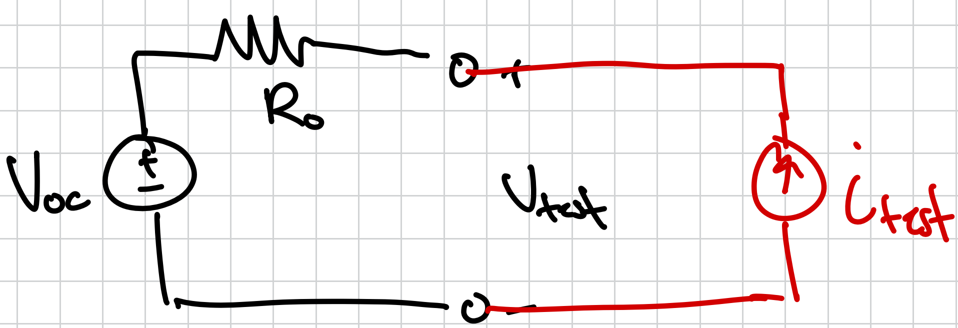


$$V_{test} = \underbrace{(a v_1 + R_1 i_2 + \dots)}_{\text{Inside Box}} + \underbrace{R_o \times i_{test}}_{\text{Outside Box}}$$

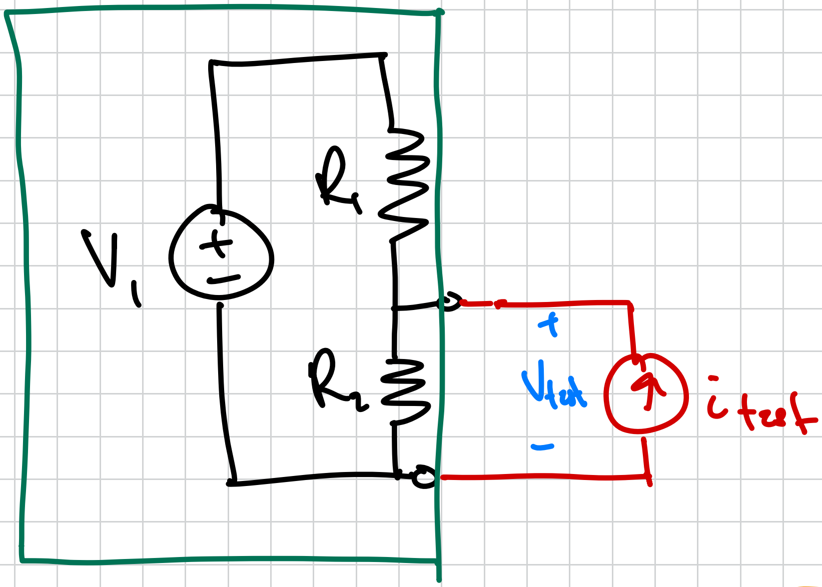
$$\boxed{V_{test} = V_{oc} + R_o i_{test}}$$

Output Resistance

Open Circuit Voltage V_{oc}



☆ Thevenin's Theorem



. . .

$$V_{test} = \underbrace{\frac{R_2}{R_1+R_2}V_1}_{V_{oc}} + \underbrace{\frac{R_1R_2}{R_1+R_2}}_{R_o}\, i_{test}$$