

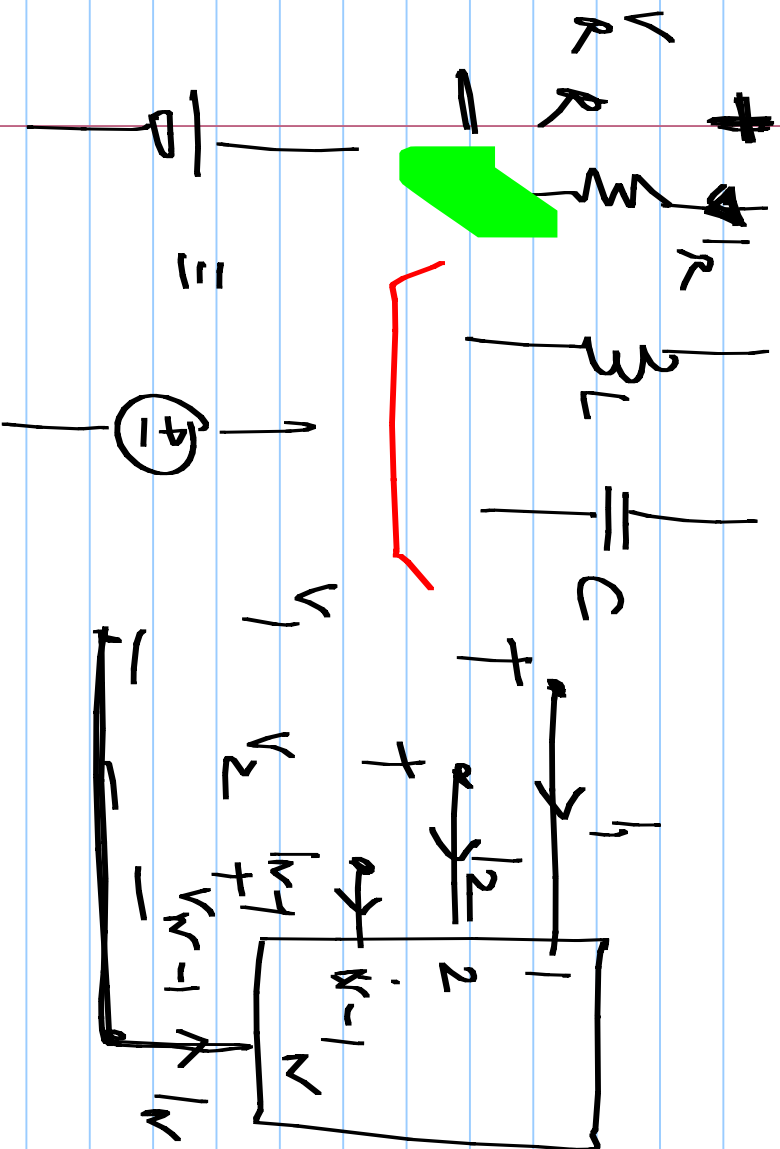
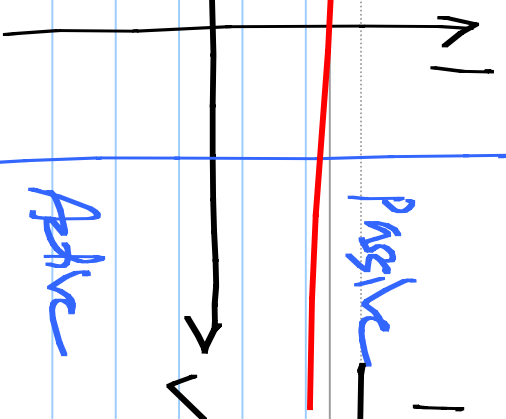
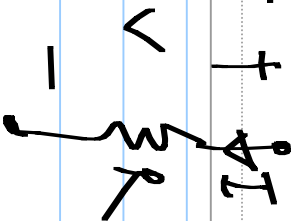
EE 2019

$$V_k \cdot I_k > 0$$

Passive

17/1/2017

Basic elements



$$\sum_{k=1}^{N-1} V_k I_k \geq 0$$

Passive

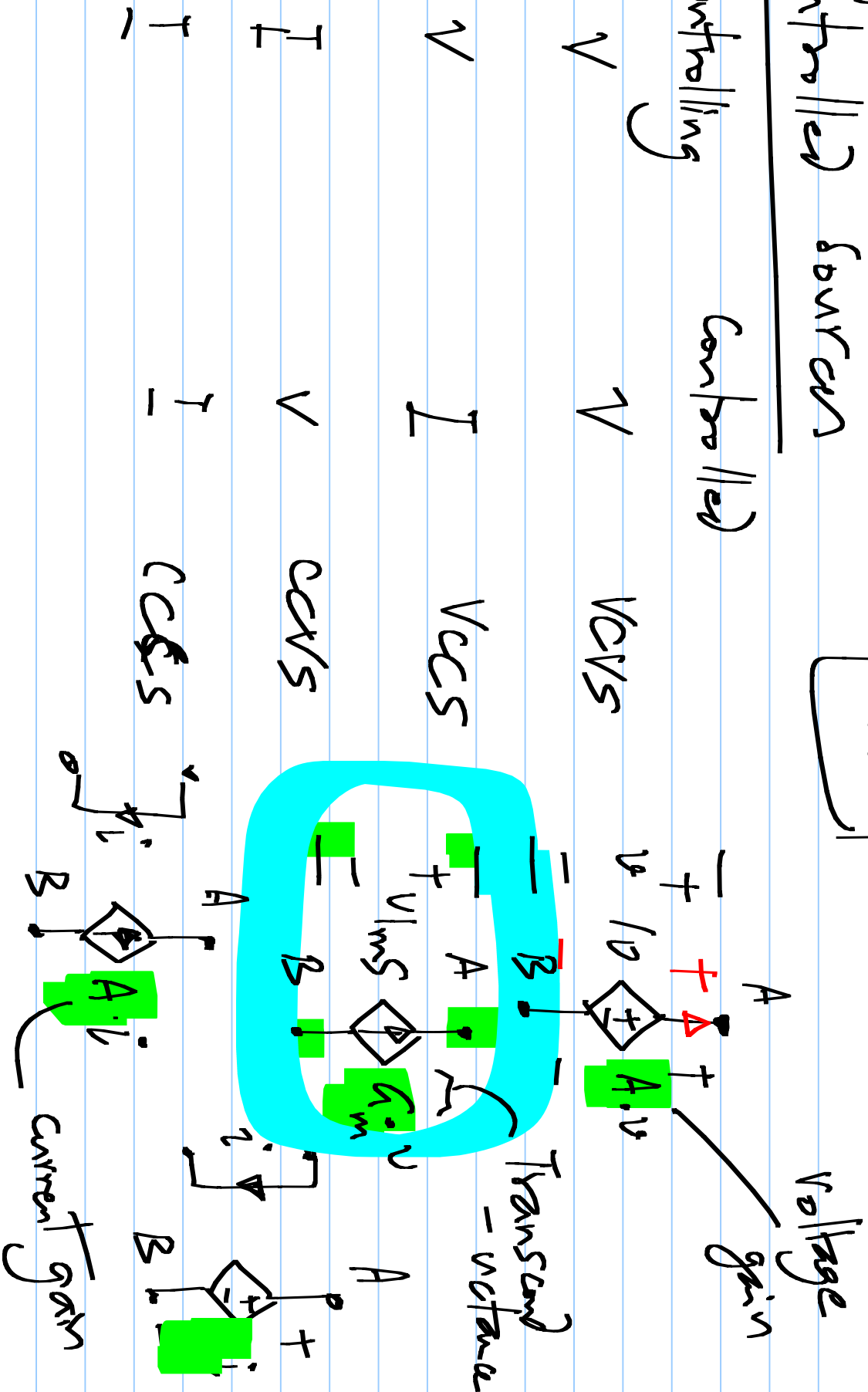
$$V = -(V_1 + V_2 + \dots + V_{N-1})$$

Dependent sources

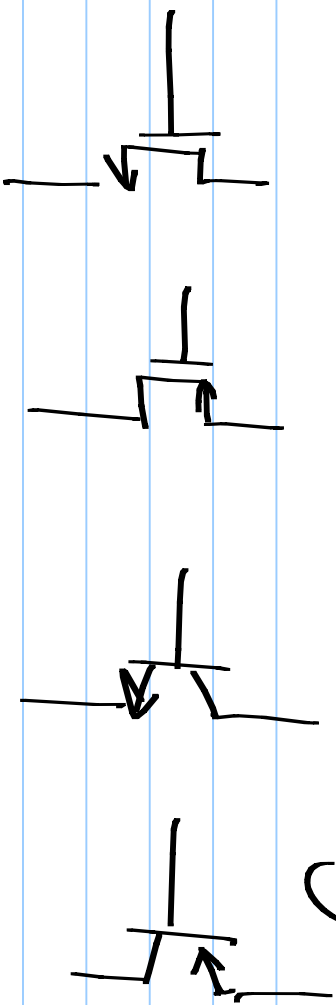
Controlled sources

I_{ms}

Controlling Controlled



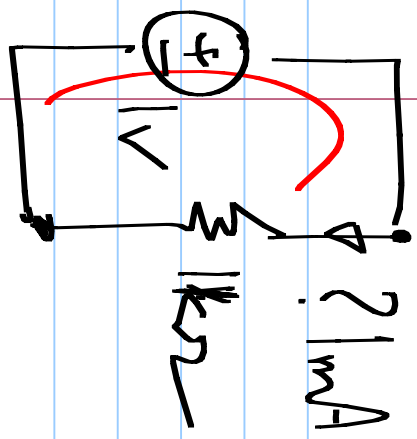
Controlled sources made using transistors



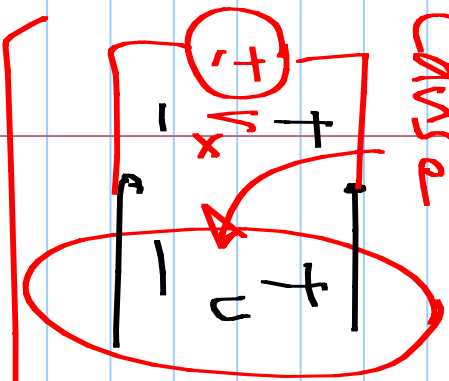
Semiconductors - highly temp. sensitive

large parameter spread

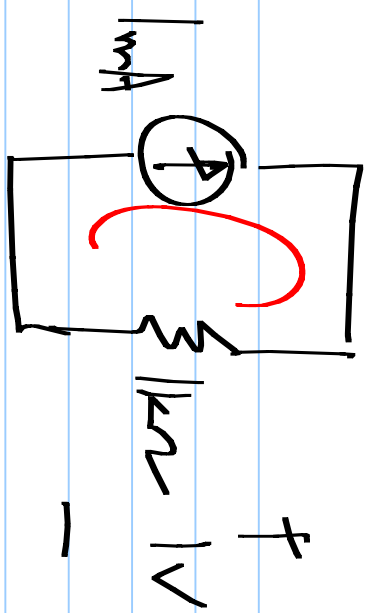
Realize accurate controlled sources using
controlled sources that have a large parameter
variation



Cause

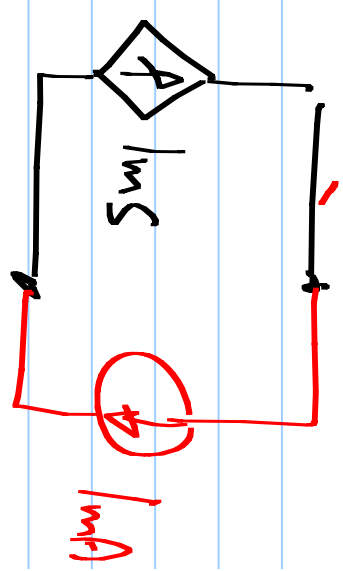
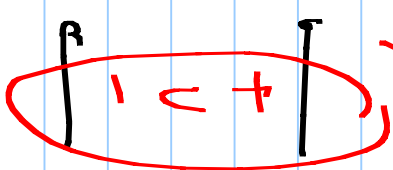
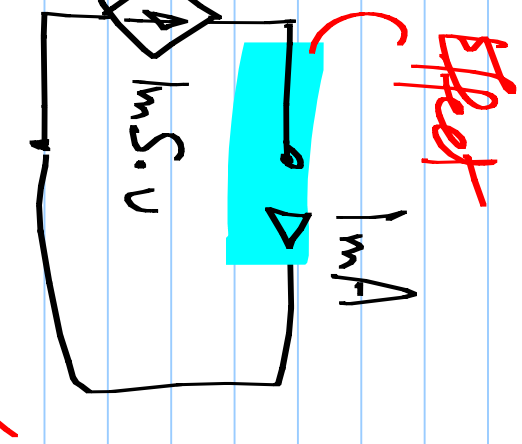


Find V_x

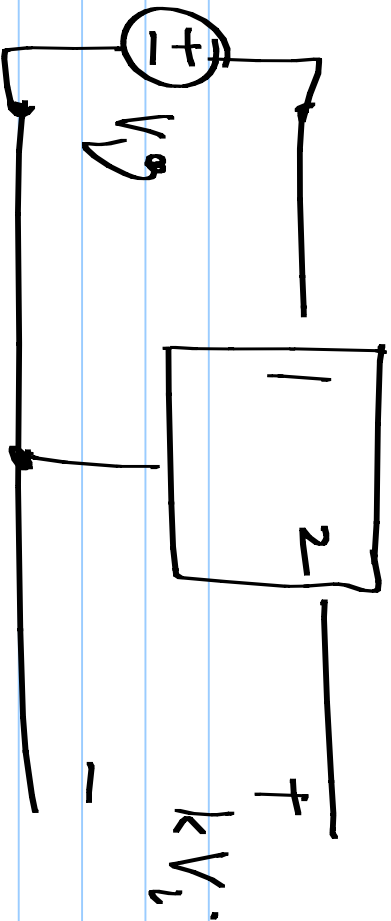


Bilateral

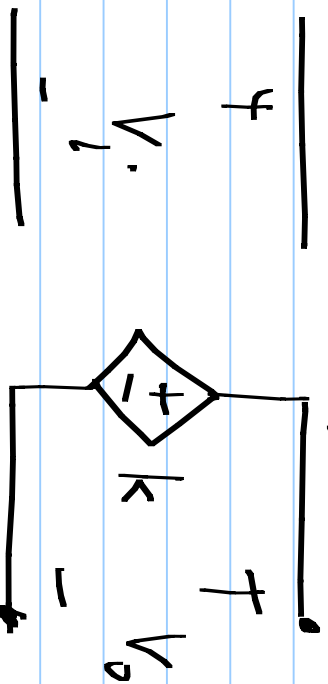
Unilateral element



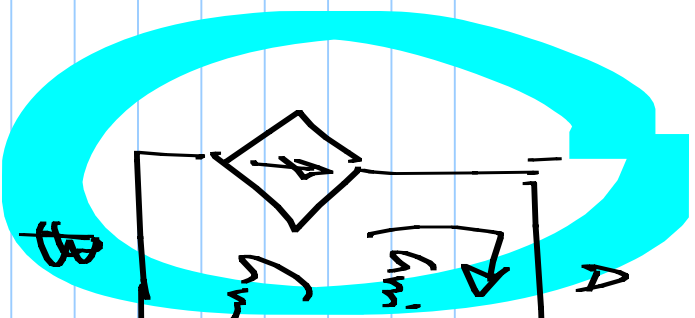
$$V_o = kV_2$$



Transistor

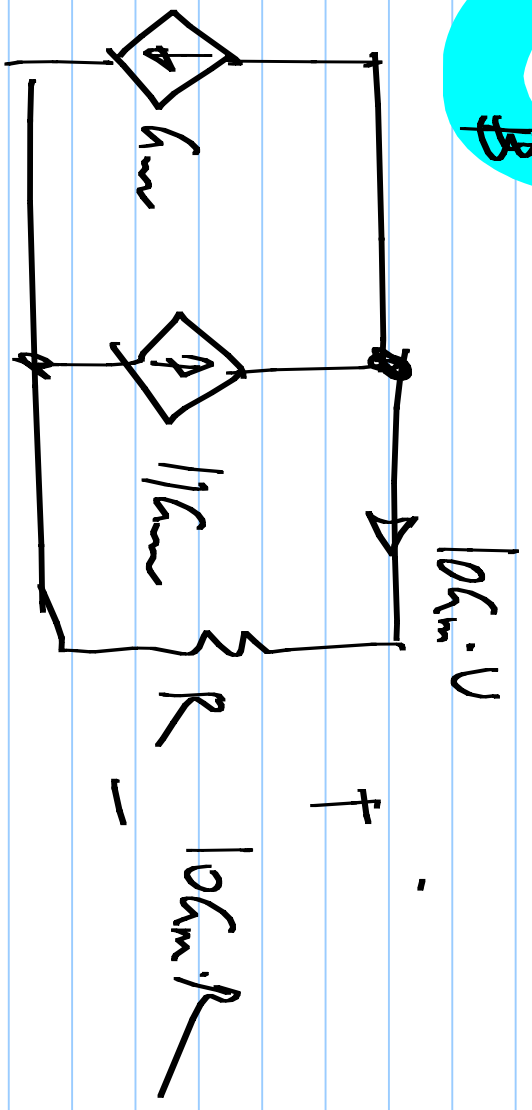


$$V_2 = 0$$



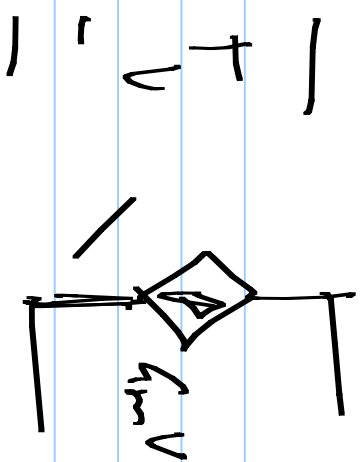
$$10 \cdot V_1$$

$$R_L = \frac{10}{g_m} \quad g_m R_L \cdot V_1$$



$$V_o = K V_i$$

Negative feedback:



* Sense the output-

* compare it to the desired value

* Control the output in a direction

that minimizes error