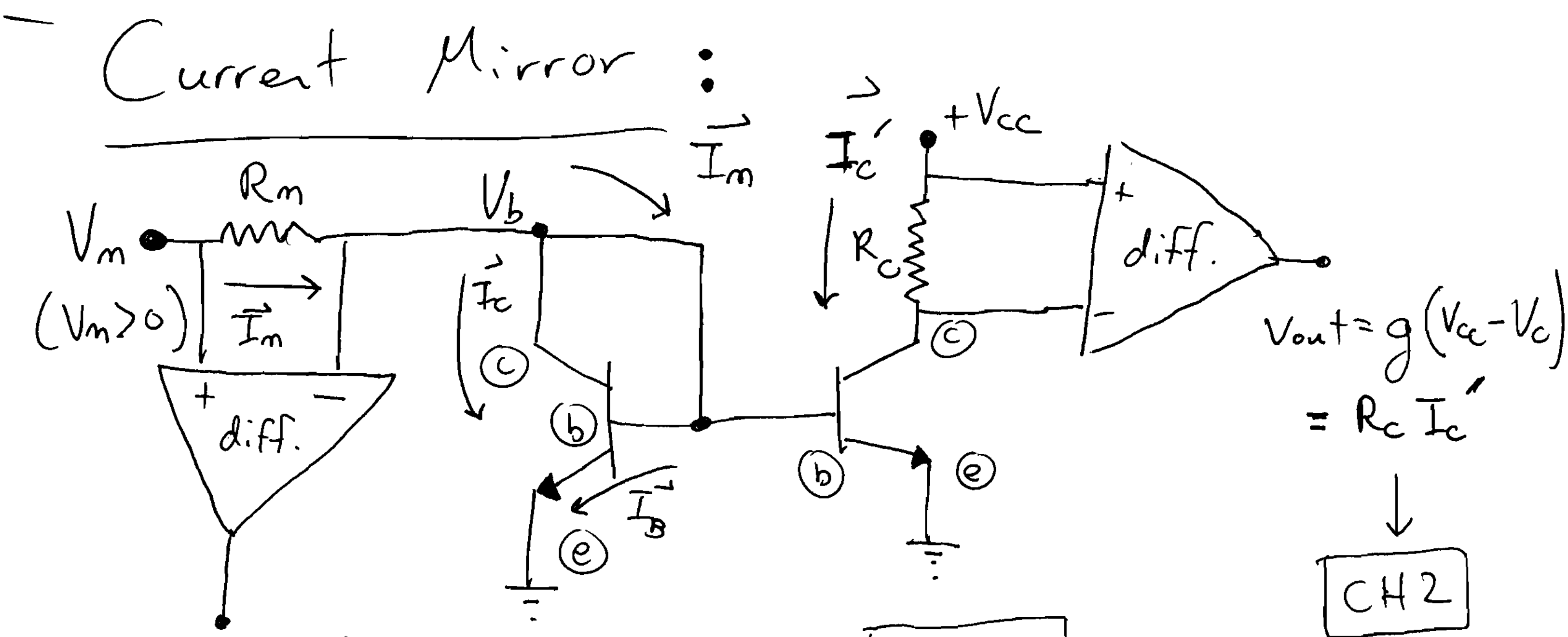
Current Mirror :



$V_{out} = g(V_m - V_b) = I_m R_m = \boxed{CH1}$

Start with two npn transistors back-to-back as shown above. In the left transistor

$$\vec{I}_m = \vec{I}_{TOTAL} = \vec{I}_c + \vec{I}_B = \beta I_B + I_B$$

also. $I_m = \dfrac{V_m - V_b}{R_m}$, therefore

$$I_m = \frac{V_m - V_b}{R_m} = (\beta + 1) I_B \text{, and}$$

renember than $I_B = I_{Diode}$

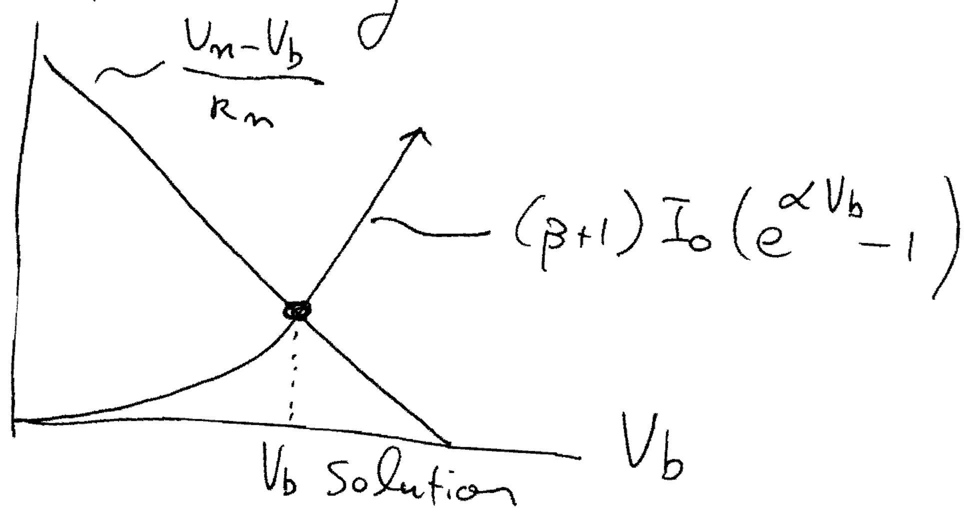
due to the current moving through the b-e pn junction.

$$I_B = I_0 \left(e^{\alpha V_b} - 1 \right) \quad \text{where } \alpha = \frac{e}{k_B T}$$

and,

$$\boxed{\frac{V_m - V_b}{R_m} = (\beta + 1) \, I_0 \left(e^{\alpha V_b} - 1 \right)}$$

Solve graphically for V_b



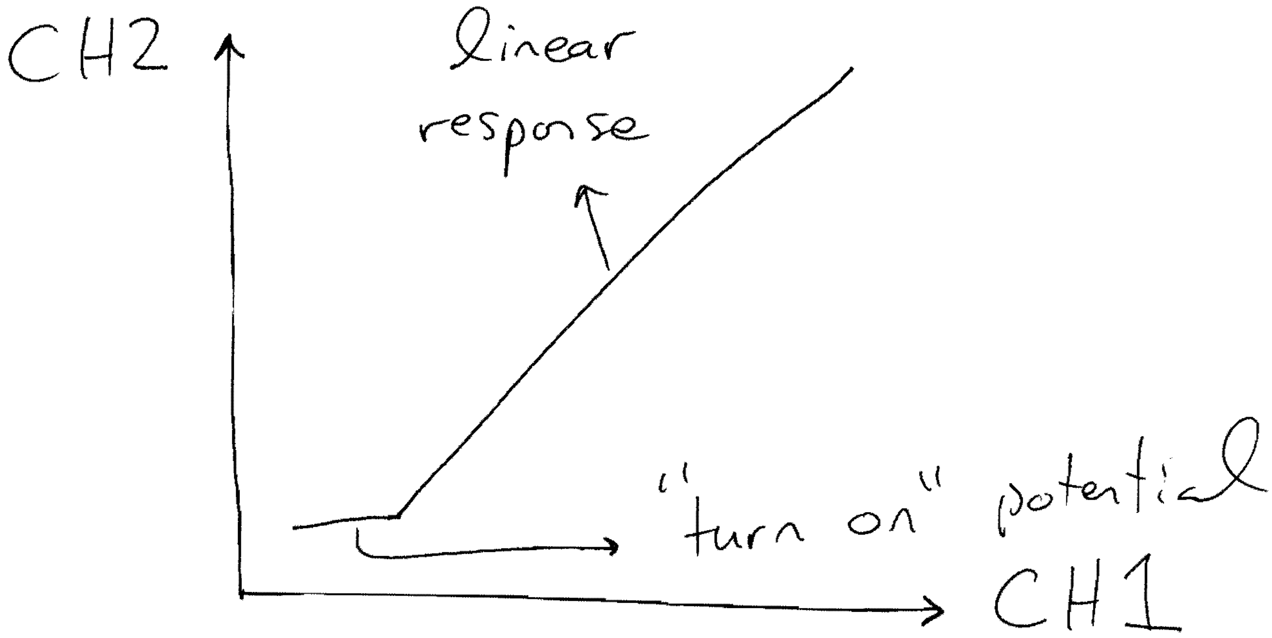
Goal: As V_m is adjusted both $\vec{I_c}$ and $\vec{I_c}'$ should have a linear response to the given applied potential.

(2)

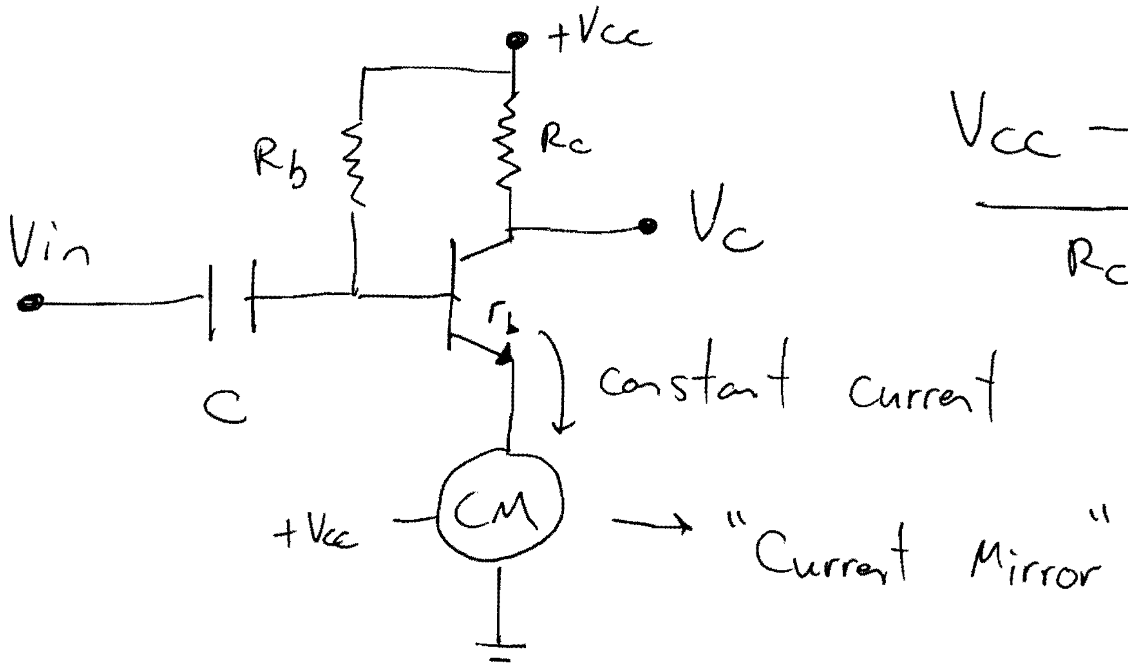
xy-mode data :

CH 1 = $V_m - V_b$ (drop across R_m)

CH 2 = $g(V_{cc} - V_c)$ (drop across R_c)



Self-Biased Amplifier :



$$\frac{V_{cc} - V_c}{R_c} = I_c$$

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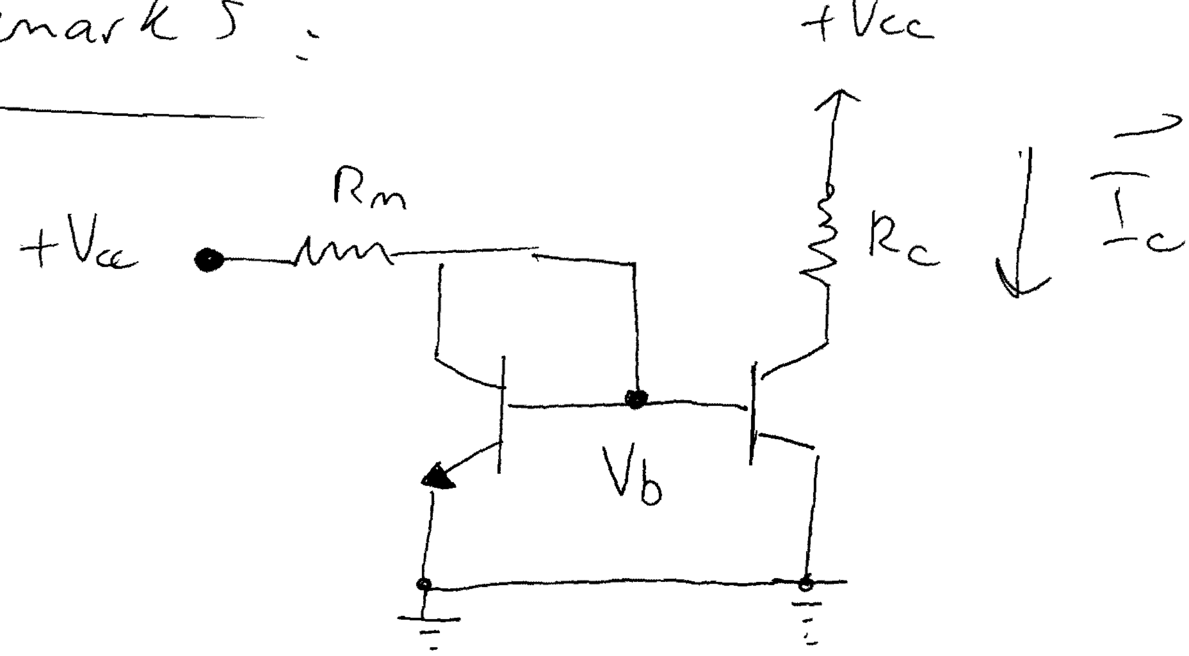
Remarks :



The whole point of the current mirror is to establish a constant V_b (shown on page ②), this constant V_b creates a constant $\vec{I}_c$. Because $\vec{I}_c$ is held constant any resistor (or circuit) will adjust it's potential drop to maintain constant current.

3A

Refer to Self Biased amplifier circuit diagram :

Conditions :

A) Want $V_C = V_{CC}/2$

B) $\dfrac{V_{CC}/2}{R_C} = I_m$

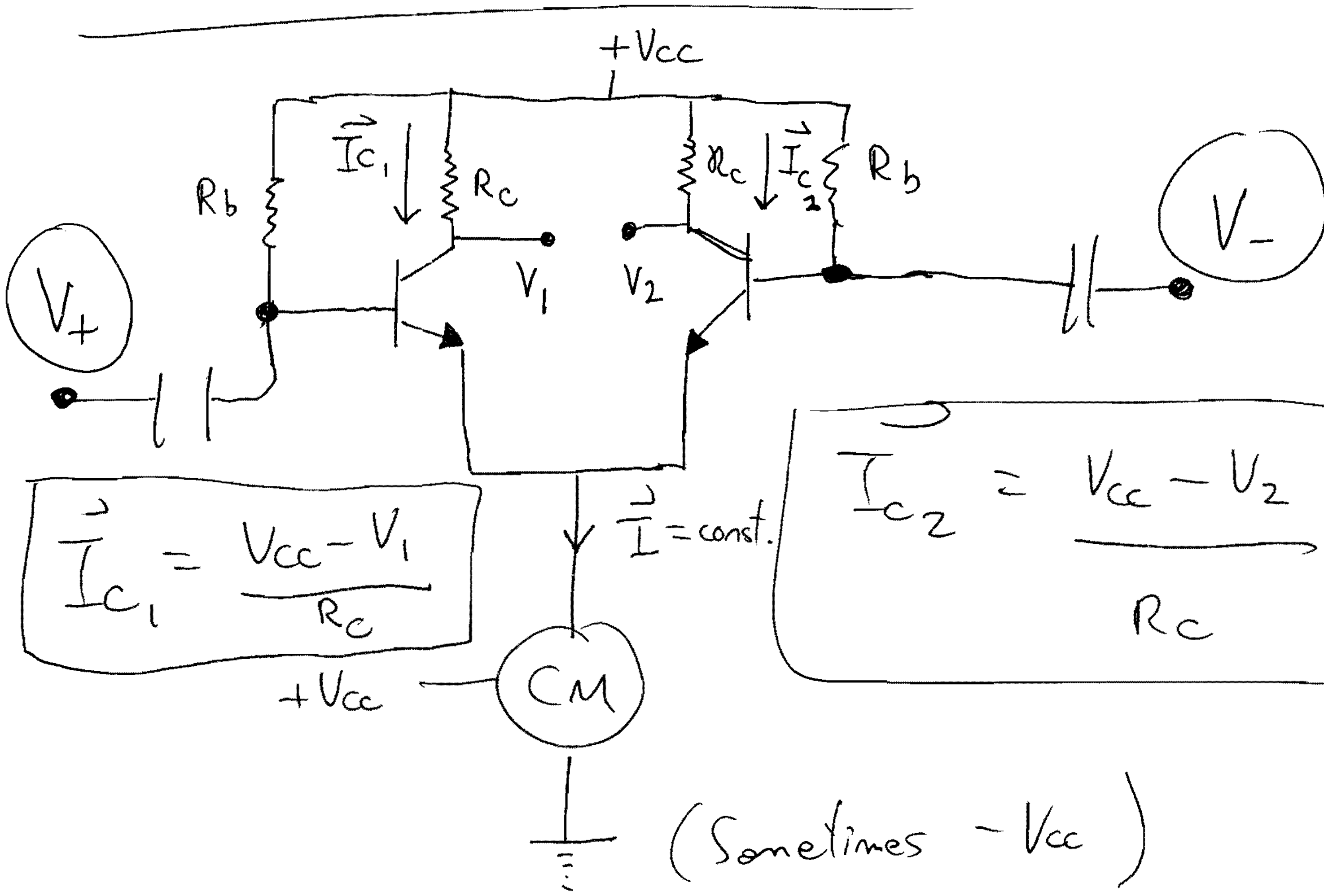
C) $\dfrac{V_{CC}}{R_b} > I_B = \dfrac{I_m}{\beta}$

D) $\left(\dfrac{V_{CC}}{R_b} \sim 10\, I_B \right)$

E) $I_m \cong 1\,mA$

Input impedance $Z_{in} = Z_C + R_b \| r_b$

Differential Amplifier :



$$\boxed{\vec{I}_{C_1} = \frac{V_{CC} - V_1}{R_C}}$$

$$\boxed{\vec{I}_{C_2} = \frac{V_{CC} - V_2}{R_C}}$$

Recall that $\vec{I}$ = constant from the current mirrior, and

$$\boxed{I_{C_1} + I_{C_2} = I}$$

Physical reasonig is very important w/ this circuit!!

Physical Reasoning:

Consider increasing V_+ input.

(a) when V_+ increases, I_{c_1} increases

(b) If I_{c_1} increases, V_1 decreases

current eqn.

(c) If $I_{c_1} \uparrow$, $I_{c_2} \downarrow$

because $I_{c_1} + I_{c_2} =$ constant

(d) If I_{c_2} decreases the V_2 increases

Therefore when

V_+ increases $\Rightarrow \begin{cases} V_1 \text{ decreases} \\ V_2 \text{ increases} \end{cases}$

So for V_+ V_1 is the inverted output, and V_2 is the non-inverted output.

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