Problemas BJT

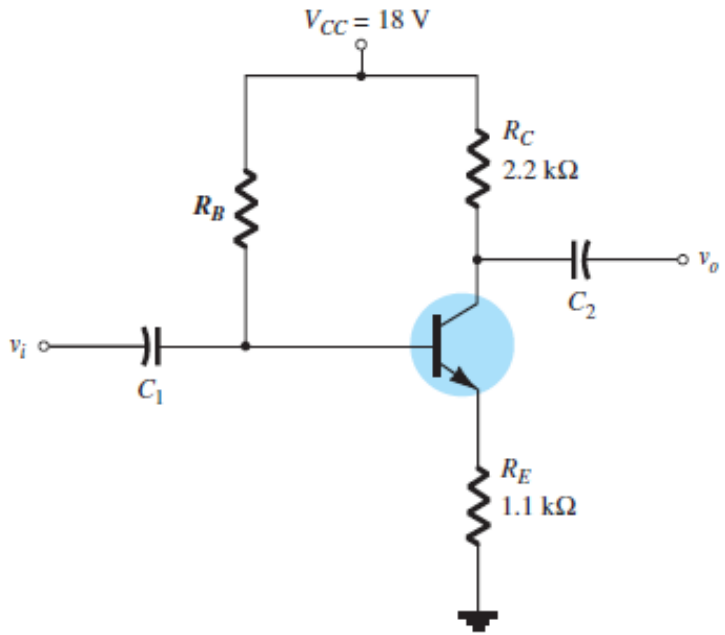


FIG. 4.26a
Red para el ejemplo 4.7.

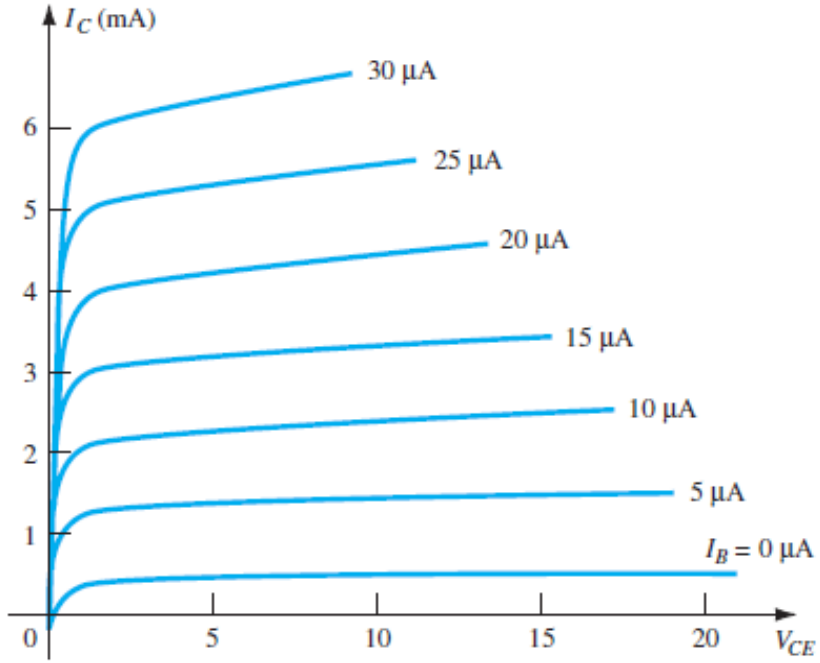


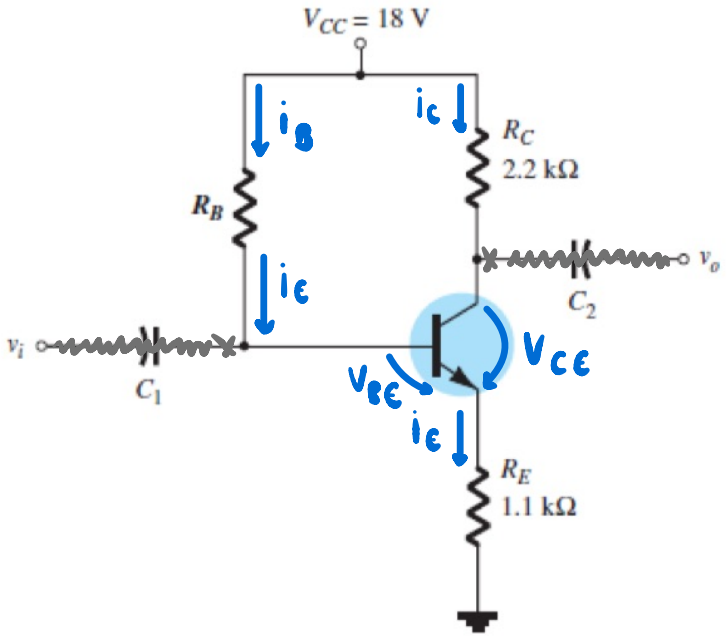
FIG. 4.26b
Ejemplo 4.7.

a. Trace la recta de carga para la red de la figura 4.26a en las características del transistor que aparece en la figura 4.26b.

b. Para un punto Q en la intersección de la recta de carga con una corriente de base de 20 μA, determine los valores de I_{C_Q} y V_{CE_Q}.

c. Determine la beta de cd en el punto Q.

d. Utilizando la beta de la red determinada en la parte c, calcule el valor requerido de R_B y sugiera un posible valor estándar.



$$V_{CC} = i_C R_C + V_{CE} + i_E R_E$$

$$V_{CC} = i_B R_B + V_{BE} + i_E R_E$$

$$i_E = i_C + i_B$$

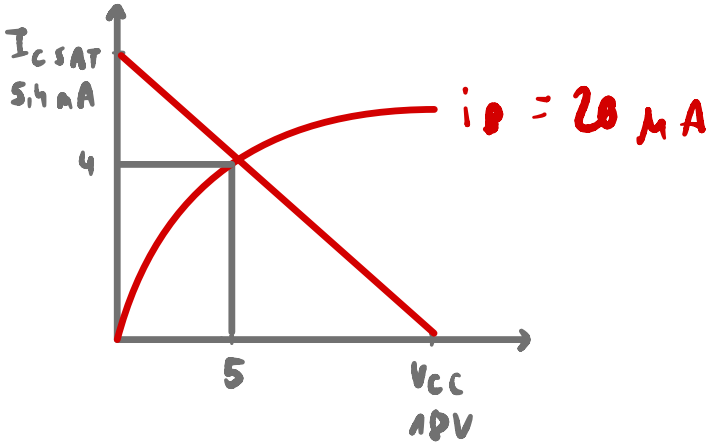
$$i_{C\,SAT} \longrightarrow SAT \rightarrow V_{CE/SAT} = 0{,}2V$$

$$i_C \leq \beta i_B$$

Establecemos SAT:

$$18 = i_C\,22K + 0{,}2 + i_C\,1.1K$$

$$i_C = \frac{17{,}8}{3{,}3K} = 5{,}4\,mA$$



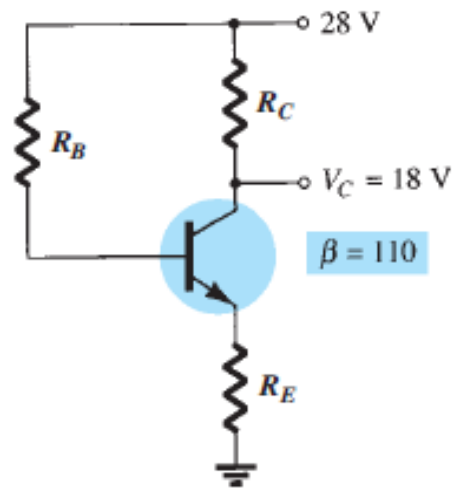
Suposición:

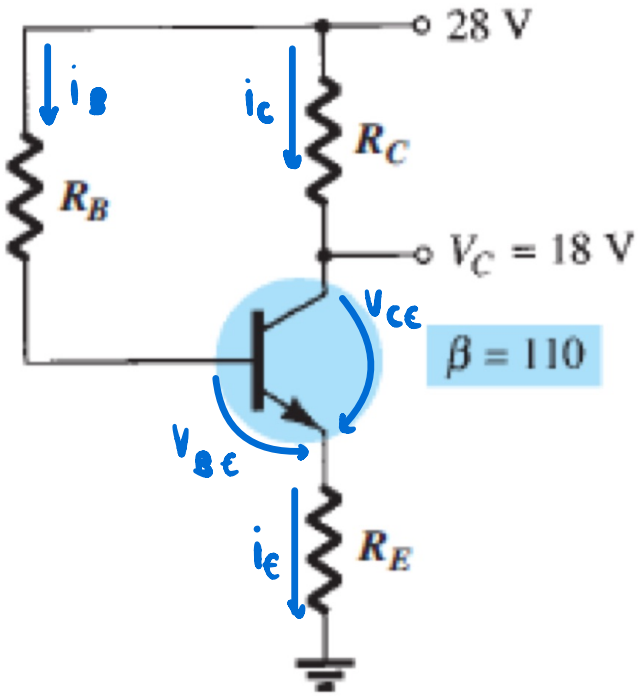
$$i_E = i_C + i_B = \beta i_B + i_B = (\beta + 1) i_B$$

Si $\beta > 100$; $(\beta + 1) \approx \beta$

$$[i_E \approx \beta i_B = i_C$$

EJEMPLO 4.23 La configuración de polarización de emisor de la figura 4.61 tiene las siguientes especificaciones: $I_{C_Q} = \frac{1}{2}I_{\text{sat}}$, $I_{C_{\text{sat}}} = 8$ mA, $V_C = 18$ V, y $\beta = 110$. Determine R_C, R_E, y R_B.





$I_{CSAT} = \frac{1}{2} i_{CSAT} = 4\,mA \equiv ACTIVA$

$I_{CSAT} = 8\,mA$

$I_C = \beta I_B \rightarrow I_B = \frac{4\,mA}{110}$

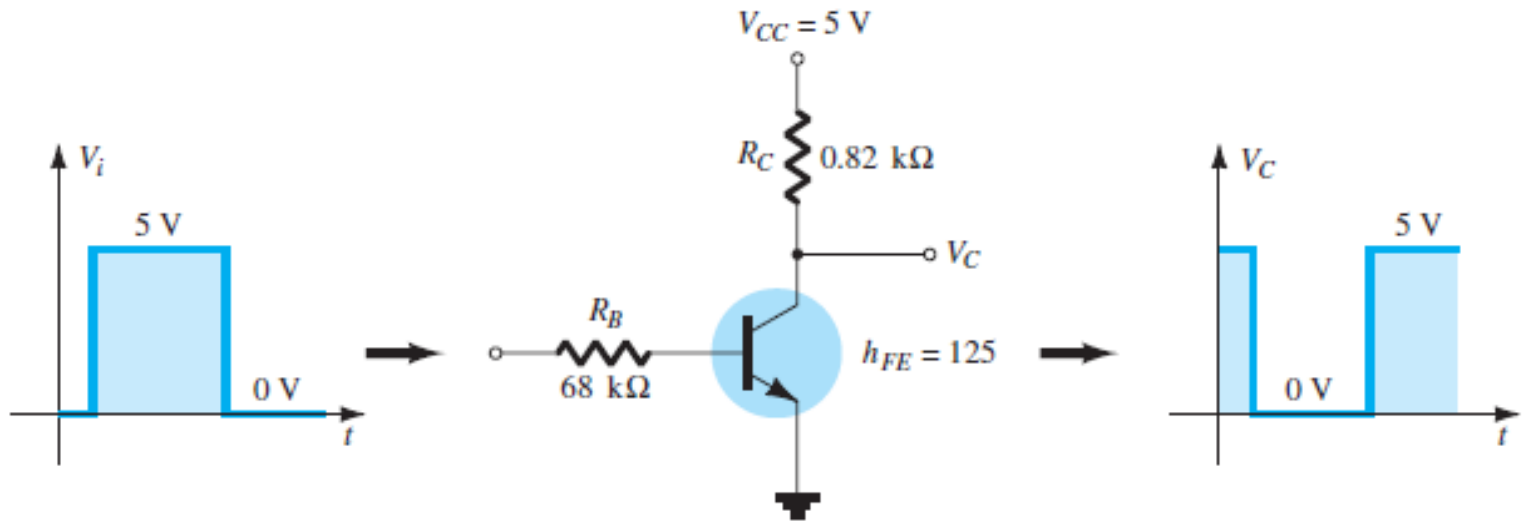
$I_E = I_C + I_B = 4m + \frac{4m}{110} \approx 4\,mA$

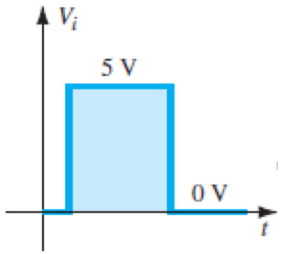
$V_{CE} = i_C R_C + V_{CE} + i_E R_E/4 \rightarrow 28 = 4m\,R_C + 18 \rightarrow R_C = \frac{10}{4m} = 2{,}5\,K\Omega$

$V_{CC} = i_B R_B + i_E R_E/4$

$V_C = 18 = V_{CE} + i_E R_E$

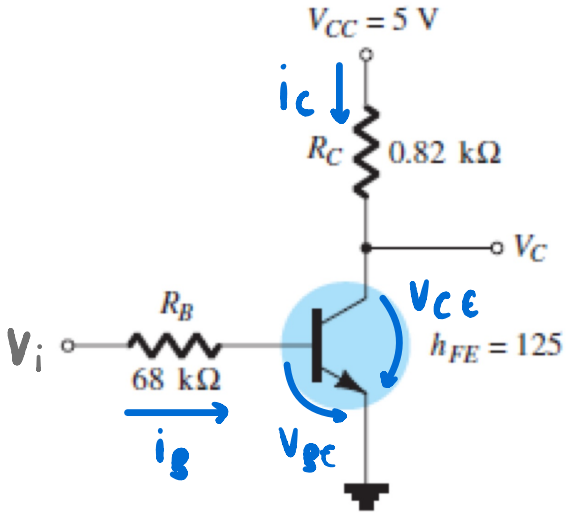
SAT → I = SAT
CORTE → I = 0
} ACTIVA → 0 < I < SAT


$V_{CC} = 5$ V
V_i
5 V
0 V
t
R_C
0.82 kΩ
V_C
R_B
68 kΩ
$h_{FE} = 125$
V_C
5 V
0 V
t



$V_c = V_{CE}$ { SAT $V_{CE\,SAT} = 0{,}2V$; CORTE $V_{CE} = V_{CC} = 5V$ }

$V_i = 0V$



$V_{CC} = i_C R_C + V_{CE}$

$V_i = i_B R_B + V_{BE}$; $5 = i_B\,68K + 0{,}7 \rightarrow i_B = 6{,}4\,\mu A$

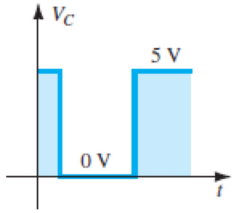
$V_i = 5V \longrightarrow$ SAT

$5 = i_{C\,SAT}\,820 + 0{,}2 \rightarrow i_{C\,SAT} = 5{,}8\,mA$

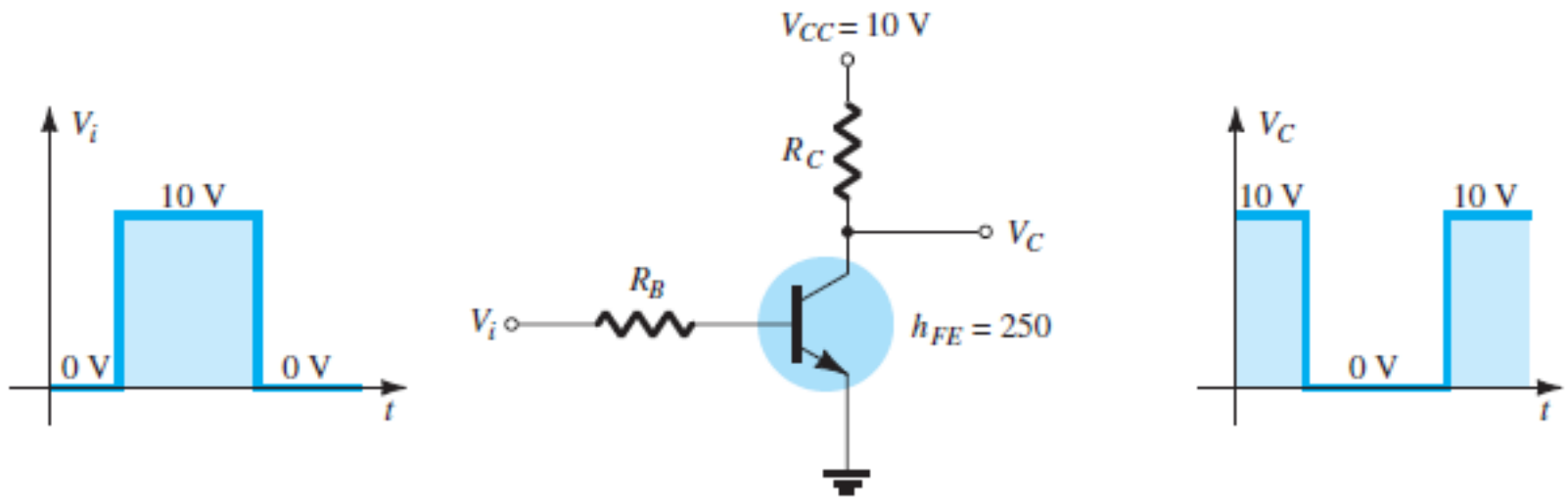
$5{,}8\,m < 125 \cdot 64\,m$ Se verifica

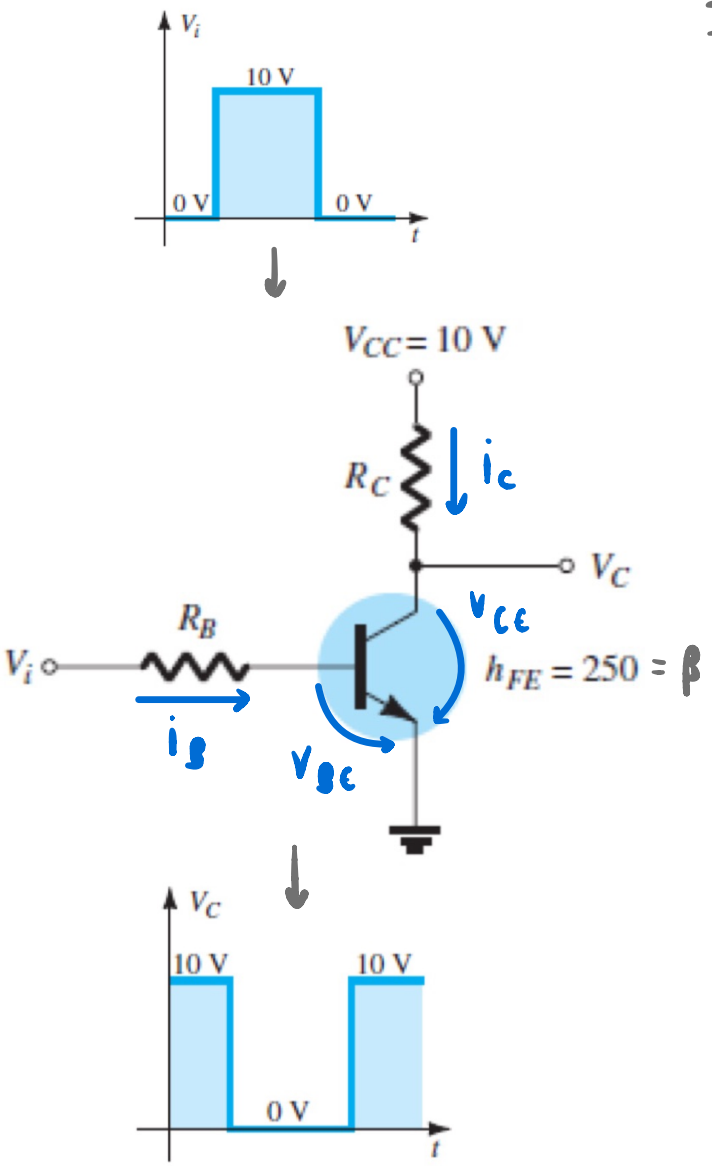
Entra	Sale
5V ⟶	0V
0V ⟶	5V

Nos lo creemos (no hecho)



EJEMPLO 4.31 Determine R_B y R_C para el inversor de transistor de la figura 4.80 si $I_{C_{sat}} = 10$ mA.





$I_{CSAT} = 10\,mA$ $\quad V_i = 0 \longrightarrow$ CORTE BE y BC POL. INV

Si $V_i = 10 \longrightarrow$ SATUR $\rightarrow i_C \leq \beta i_B \rightarrow \underline{i_C = \beta i_B}$

Resuelvo el límite

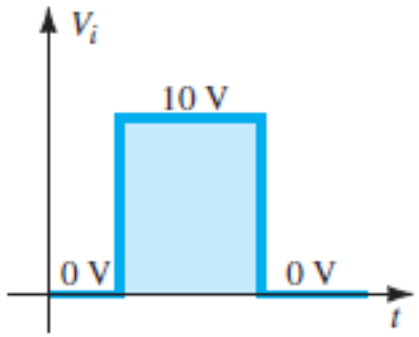
$V_{CC} = i_C R_C + V_{CE} \longrightarrow 10 = i_{CSAT} R_C + 0,1$

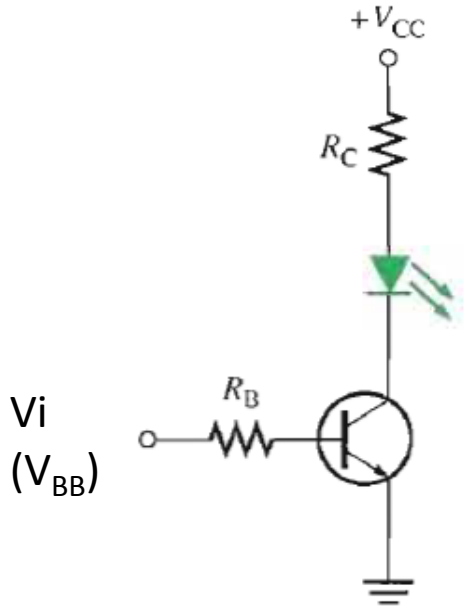
$10 = 10m\, R_C + 0,1 \longrightarrow R_C = 980\,\Omega$

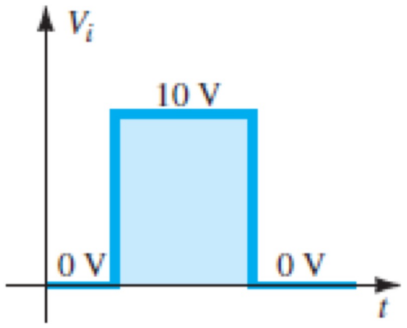
$V_i = i_B R_B + V_{BE} \longrightarrow 10 = i_B R_B + 0,7 \longrightarrow i_B = \frac{10m}{20} = 0,04m = 40\mu A$

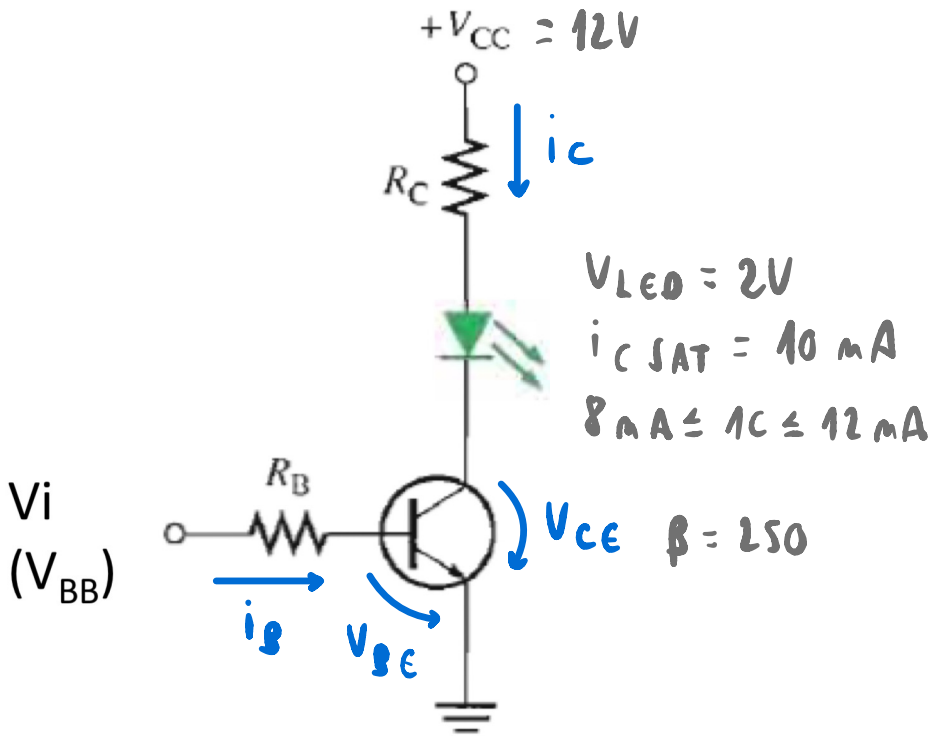
$R_B \leq 232,5\,K\Omega$

Vcc=12V; V_{LED}= 2V ; β=250;
$I_{LED\text{-}min}$=8mA, I_{LED_nom}=12mA.









Vi
(V_{BB})

$V_{CC} = i_C R_C + V_{LED} + V_{CE}$

$V_i = i_B R_B + V_{BE}$

$V_i = 0 \longrightarrow$ CORTE $\longrightarrow i_{LED} = i_C = \emptyset\,A$ Led apagado

Si $V_i = 10 \longrightarrow$ Led encendido

(Activa → SCI) No necesario (Probar 1º SAT)

Forzamos SAT $\longrightarrow i_C \leq \beta i_B$

$12 = 10m\,R_C + 2 + 0{,}2$; $R_C = 98\,m\Omega$

$10 = i_B R_B + 0{,}7$; $R_B = \frac{10m}{250} = 40\,M\Omega$

$i_C = \beta i_B \longrightarrow R_B \leq 40M\Omega$

Se cumple