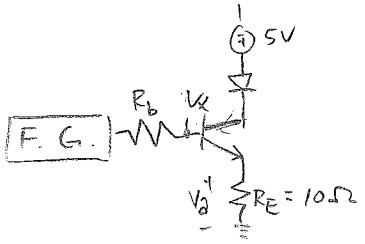
ECEn 340 Lab 3 Notes

Transmitter

When the signal is high (3.3V), the LED should produce a current of 100 mA.

When the signal is low (0V), the LED should be off



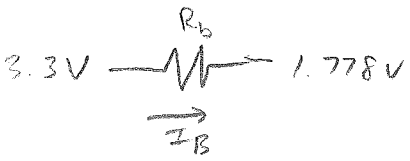
$I_C = 100\ mA$ $\beta = 300$

$$V_{BE} = V_T \ln\left(\frac{I_C}{I_S}\right) = 0.026 \ln\left(\frac{0.1}{10^{-14}}\right)$$

$$= 0.778\ V$$

On large signal $I_E = I_C$ $I_E = 0.1A$ $V_2 = (10)(0.1) = 1\ V$

$V_x = V_2 + V_{BE} = 0.778 + 1 = 1.778\ V$



$$I_B = \frac{I_C}{\beta} = \frac{0.1}{300} = 0.000333$$

$$R_b = \frac{3.3 - 1.778}{0.000333} = 4566\Omega = 4.566\ k\Omega$$

For $R_E = 1\Omega$

$I_C = 0.1A$ $V_2 = (0.1)(1) = 0.1\ V$

$V_x = V_2 + V_{BE} = 0.7 + 0.1 = 0.8\ V$

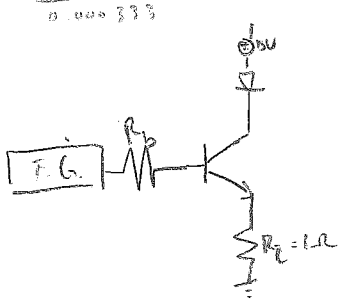
$V_B < V_C$ $V_B < V_E$: Cutoff : low

$V_B > V_C$ $V_B > V_E$: Saturation : high

$$R_b = \frac{3.3 - 0.8}{0.000333} = 7500\ \Omega$$

$f = 0.5\ Hz$

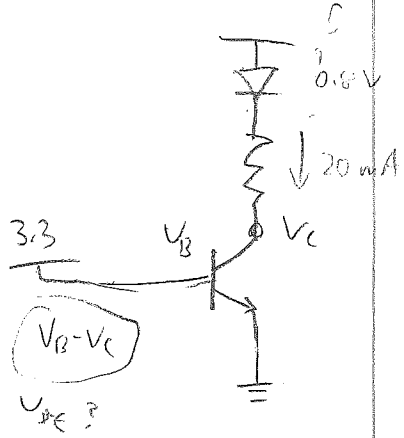
$Max\ I_C = 20\ mA$



For Hit Indicator

$I_E = 0.02A$ $V_2 = (0.02)(1) = 0.02\ V$

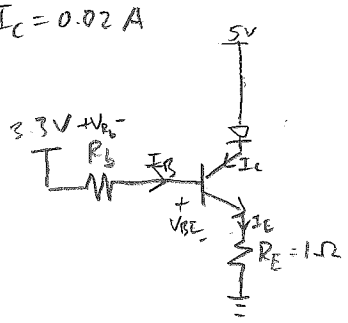
$V_B = 3.3V$ $V_E = 0$ $V_C < V_B$



For Hit Indicator

$f = 0.5\,Hz$

$I_C = 0.02\,A$



@ $V_{in} = 3.3V$: $V_B > V_E$ $V_B > V_C$

@ $V_{in} = 0V$: $V_B < V_E$ $V_B < V_C$

$I_E = I_C = 0.02A$

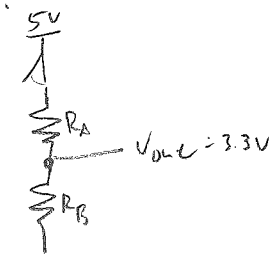
$V_B = V_{BE} + I_E R_E = 0.756428$

$V_{BE} = V_T \ln\left(\frac{I_C}{I_S}\right) = 0.736428$

$V_{R_b} = 3.3 - V_B = 2.54357$

$I_B = \frac{I_C}{\beta} = \frac{0.02}{200}$

$R_b = \frac{V_{R_b}}{I_B} = 38153\,\Omega$



$1.7 = 5\,\frac{R_A}{R_A + R_B}$ $\quad \frac{1.7}{5} = \frac{R_A}{R_A + R_B}$ $\quad 1.7R_A = \frac{1.7}{5}R_A + \frac{1.7}{5}R_B$

$0.66\,R_A = \frac{1.7}{5}R_B$ $\quad R_A = 0.515\,R_B$