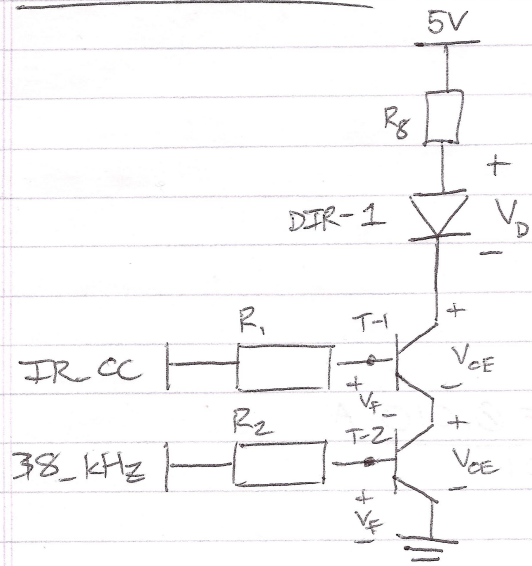
IR Transmitter



Assume, from datasheets:

BJTs

- $V_{CE} = 0.3\ V$
- $V_f = 0.5\ V$
- $h_{fe} = 10$

Trying to maximize P_{DIR-1}:

$V_{D\_max} = 1.8\ V$

@ $I_{D\_max} = 0.1\ A$

$$5 - I_D R_8 - V_D - 2V_{CE} = 0$$

$$5 - 0.1 R_8 - 1.8 - 0.6 = 0 \longrightarrow 2.6 = 0.1 R_8$$

$$\underline{R_8 = 26\ \Omega}$$

Given V_F and V_{CE}:

$$V_{BT-1} = 0.8\ V \longrightarrow 5 - I_{B1} R_1 = 0.8$$
$$V_{BT-2} = 0.5\ V \longrightarrow 5 - I_{B2} R_2 = 0.5$$

① $I_{B1} R_1 = 4.2$

$I_{C1} = h_{fe} \cdot I_{B1} \longrightarrow 0.1 = 10 I_{B1} \longrightarrow \underline{I_{B1} = 0.01\ A}$

$0.01 R_1 = 4.2 \longrightarrow \underline{R_1 = 420\ \Omega}$

② $I_{B2} R_2 = 4.5$

$I_{C2} = I_{E1} = I_1 + I_{C1} = h_{fe} \cdot I_{B2}$

$0.1 + 0.01 = 0.11 = 10 \cdot I_{B2} \longrightarrow \underline{I_{B2} = 0.011\ A}$

$0.011 R_2 = 4.5 \longrightarrow \underline{R_2 = 409\ \Omega}$

Choosing practical values:

- $R_1 = R_2 = 422\ \Omega$
- $R_8 = 26.1\ \Omega$

Proof

① $5 - I_C R_8 - V_D - 2V_{CE} = 0$

② $I_{B1} \cdot R_1 = 4.2$

③ $I_{B2} \cdot R_2 = 4.5$

For 2

$I_{B1}(422) = 4.2 \longrightarrow \underline{I_{B1} = 0.010\ A}$

$I_{E1} = I_C + I_{B1} = I_C + 0.01$

For 3

$I_{B2}(422) = 4.5 \longrightarrow \underline{I_{B2} = 0.011\ A}$

$I_C + 0.01 = 10(0.011) \longrightarrow \underline{I_C = 0.1\ A}$

For 1

$5 - (0.1)(26.1) - V_D - 2(0.3) = 0$

$5 - 2.61 - V_D - 0.6 = 0 \longrightarrow \underline{V_D = 1.79\ V}$

Just shy of maximum values. ✓