bjt_mirror_1.sqproj

Description

Shown in Fig. 1 is a simple current mirror. Since the base-emitter voltage (V_{BE}) for the two BJTs is the same in this circuit, the reference current I_{C1} of Q_1 is "mirrored" on the transistor Q_2, i.e., I_{C2} is made equal to I_{C1}. This allows us to change I_{C2} *irrespectively* of the voltage V_{C2} by simply changing the resistance R_1, since

$$I_{C1} \approx \frac{V_{CC} - 0.7\ V}{R_1}\,. \tag{1}$$

In practice, the current I_{C2} is not quite independent of V_{C2} because the transistor Q_2 has a finite output resistance due to the Early effect. Thus, I_{C2} is found to increase slightly with V_{C2} (see Fig. 2), and the slope $\partial I_{C2}/\partial V_{C2}$ is an important figure of merit (smaller the better) for any current mirror.

The other non-ideality is due to the requirement that the transistors must remain in the active region; therefore the circuit will not work as desired when V_{C2} is not sufficiently large.

Assignments

1. Plot I_{C1} and I_{C2} as a function of V_{C2} (V_{C2} can be varied by varying the resistance R_2) and comment on the plot.

2. Change R_1 to $R_1/2$, and repeat (1).

3. Double the value of the Early voltage (V_A) of Q_2 and observe the effect on the slope of the I_{C2} versus V_{C2} curve.

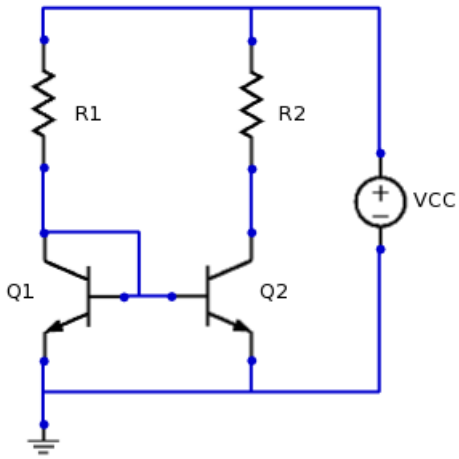

Figure 1: Circuit schematic for simple current mirror.

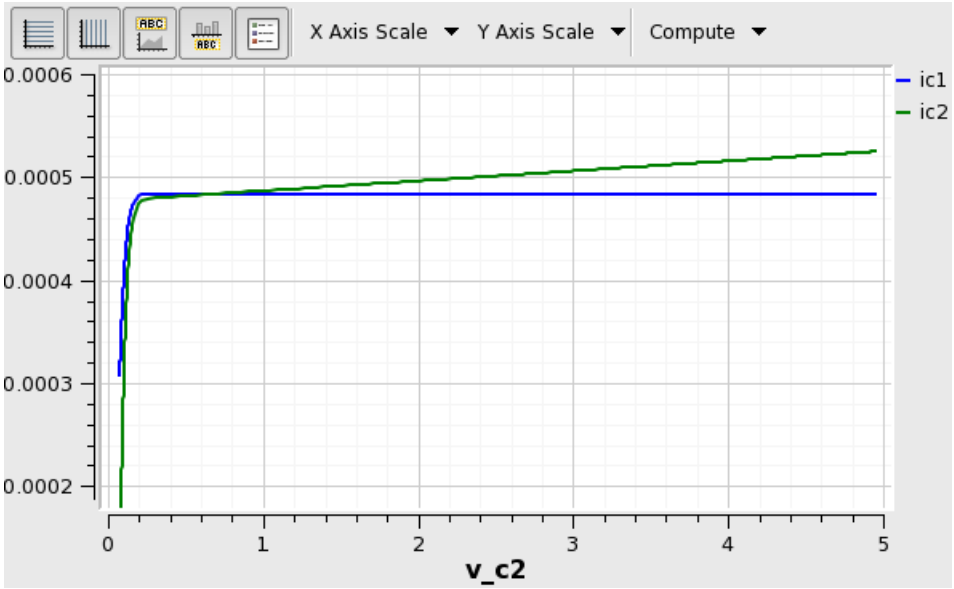

Figure 2: I_{C1} and I_{C2} versus V_{C2} for the current mirror of Fig. 1.