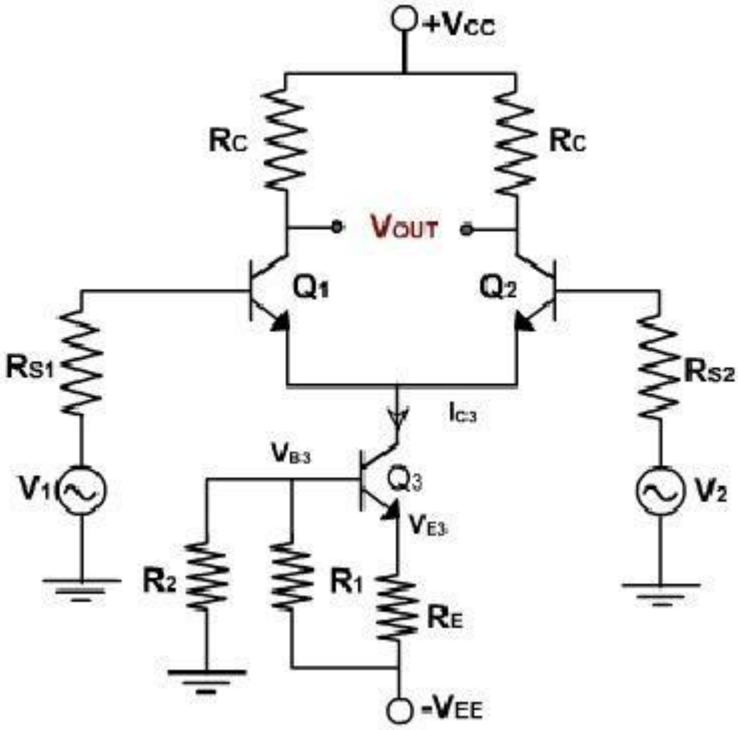
CONSTANT CURRENT BIAS METHOD

In the differential amplifiers discussed so far the combination of R_E and V_{EE} is used to step up the dc emitter current. We can also use constant current bias circuit to set up the dc emitter current if desired. In fact, the constant bias current circuit is better because it provides current stabilization and in turn assures a stable operating point for the differential amplifier. The figure shows the dual input, balanced-output differential amplifier using a resistive constant current bias. Note that the resistor R_E is replaced by a constant current transistor Q_3circuit. The dc collector current in transistor Q_3 is established by resistors $R_{1,}R_2$ and R_3 and can be determined as follows. Applying the voltage-divider rule. The voltage at the base of transistor Q_3 is



DUAL INPUT, BALANCED OUTPUT DIFFERENTIAL AMPLIFIER USING CONSTANT CURRENT BIAS

$$I_{E1} = I_{E2} = \frac{I_{C3}}{2} = \frac{V_{EE} - \left[\frac{R_2}{R_1+R_2} V_{EE}\right] - V_{BE3}}{2R_E}$$

$$V_{B3} = \frac{R_2}{R_1+R_2} (-V_{EE})$$

$$V_{E3} = V_{B3} - V_{BE3}$$

$$= -\frac{R_2}{R_1+R_2} V_{EE} - V_{BE3}$$

$$I_{BE3} = I_{C3} = \frac{V_{E3} - (-V_{EE})}{R_E}$$

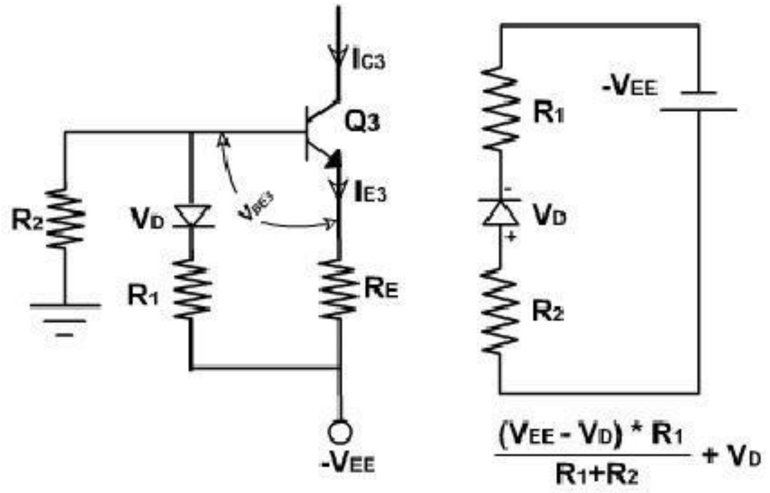
$$= \frac{V_{EE} - \left(\frac{R_2}{R_1+R_2}\right) V_{EE} - V_{BE3}}{R_E}$$

The collector current I_{C3} in transistor Q3 is fixed and must be invariant signal is injected into either the emitter or the base of Q3.thus the transistor Q3 is a source of constant emitter current for transistor Q1 and Q2 of the differential amplifier.

Recall that in the analysis of differential amplifier circuit with emitter bias we required that R_b>>I_C.Besides supplying constant emitter current the constant current bias also provides a very high source resistance since the ac equivalent of the dc current source is ideally a open circuit.therefore the performance equations obtained for the differential amplifier configuration using emitter base are also applicable to differential amplifier using constant current bias.

To improve the thermal stability of constant bias replace R1 by diodes D1 and D2. Note that high to flows to the node at the base of Q3 and then divides paths I_{B3} if the temperature Q3 increases the emitter voltage V_{BE}.

In silicon units V_{BE}decreases 2mv/c and in germanium units V_{BE} decreases 1.6mv/c.this decreased V_{BE} tends to raisethe voltage drop across R2and in turn current I_E.for better performance of transistor CA3086 have been used a constant current bias.



$$(V_{EE} - V_D)\ \frac{R_1}{R_1+R_2} + V_D = V_{BE3} + I_{E3}R_E$$

where V_D is the diode voltage. Thus,

$$I_{E3} = \frac{1}{R_E}\left\{ V_{EE}\ \frac{R_1}{R_1+R_2} + V_D\ \frac{R_1}{R_1+R_2} - V_{BE3} \right\}$$

If R_1 and R_2 are so chosen that

$$\frac{R_2}{R_1+R_2}\ V_D = V_{BE3}$$

then,

$$I_{E3} = \frac{1}{R_3} \cdot \frac{V_{EE}R_1}{R_1+R_2}$$

$$R2 = (V_{EE} - 1.4V)/I_{E3}$$

$$V_{E3} = -V_{EE} + V_Z - V_{BE3}$$

$$I_{E3} = (V_{E3} - (-V_{EE}))/R_E$$

$$I_{E3} = (V_Z - V_{BE3})/R$$

$$R2 = (V_{EE} - V_Z)/I2$$