\[ V_{EB2} = V_T \ln \frac{I_{C2}}{I_{S2}} = V_T \ln \frac{I_{E2}}{I_{S2}} \quad \text{because base current is ignored} \]

\[ I_{E2} = \frac{\Delta V_{EB}}{R_3} \]

Now double \( I_{S1} \) and \( I_{S2} \). \( \Delta V_{EB} \) is constant. See (4.272)

Therefore \( I_{E2} \) and \( I_{C2} \) are constant

So \( V_{EB2} \) Changes by \( V_T \ln \frac{1}{2} = -18 \text{mV} \)

From (4.248) \( V_{EB2} = V_{60} - V_T \left[ (6-\alpha) \ln T - \ln (EG) \right] \)

\[
\frac{\Delta V_{EB2}}{dT} = \frac{-V_T (6-\alpha) - (6-\alpha) \ln T + \frac{V_T}{T} \ln (EG) - V_{EB2}}{T}
\]

\[
= \frac{V_{EB2} - V_{60} - V_T (8-\alpha)}{T}
\]

Under nominal conditions, the slope of the \( V_{EB2} \) term, and the slope of the \( \Delta V_{EB} \) term at the output are set equal in magnitude and opposite in polarity at 25°C to set \( T_{CF} = 0 \). However, under the specified conditions, \( V_{EB2} \) has fallen by 18mV, and its slope has fallen by \( \frac{18 \text{mV}}{25+273} = \frac{18}{298} = 60 \frac{\text{mV}}{\text{°C}} = 60 \frac{\mu \text{V}}{\text{°C}} \)

Since \( V_{EB2} \) contributes directly to the output, \( \text{[see (4.26)]} \)

the output slope changes by the same amount.

Therefore \( \frac{\Delta V_{OUT}}{dT} \bigg|_{T=25^\circ C} = -60 \frac{\mu \text{V}}{\text{°C}} \)

With \( I_{S1} \) and \( I_{S2} \) doubled from the nominal value but the gain equal to the nominal value, SPICE gives 

\[
\frac{\Delta V_{OUT}}{dT} \bigg|_{T=25^\circ C} = -58 \frac{\mu \text{V}}{\text{°C}}
\]

With the gain readjusted so that \( V_{OUT} = \text{target at 25°C} \), 

\[
\frac{\Delta V_{OUT}}{dT} \bigg|_{T=25^\circ C} = 0
\]

Therefore, the case of \( I_{S} \neq \text{nominal} \) can be corrected by trimming the gain to set the output equal to the target.
Because \( n_3 = m_4 \), \(|D_3| = |D_4| = |D_1| = |D_2| = I_{BIAS}\)

KVL: \( V_{GS1} - V_{GS2} = I_{BIAS} R \)

Ignore body effect \( \rightarrow V_{T1} = V_{T2} \)

\[ V_{OV1} - V_{OV2} = I_{BIAS} R \]

\[ \sqrt{\frac{2I_{BIAS}}{\mu n C_{ox}(W/L)_1}} - \sqrt{\frac{2I_{BIAS}}{\mu n C_{ox}(W/L)_2}} = I_{BIAS} R \]

\[ \sqrt{\frac{2I_{BIAS}}{\mu n C_{ox}} \left( \frac{1}{(W/L)_1} - \frac{1}{(W/L)_2} \right)} = I_{BIAS} R \]

\[ I_{BIAS} = \frac{2}{\mu n C_{ox} R^2} \left( \frac{1}{(W/L)_1} - \frac{1}{(W/L)_2} \right)^2 \]

As \( T \uparrow \), \( R \uparrow \) and \( \mu n \downarrow \) \((\mu n \propto T^{-n})\). These effects tend to cancel. The precise behavior depends on the exact dependence of \( \mu n \) and \( R \) versus \( T \).

Small signal model

\[ V_{DD} \]

\[ k_{CL} \quad I_X = \frac{V_{DD}}{\frac{1}{r_{o3}} + \frac{1}{q_{m1} r_{m4}}} \]

\[ \rightarrow V_{T1} \left( \frac{1}{r_{o3}} + q_{m1} \right) = I_X + \frac{V_{DD}}{\frac{1}{r_{o3}}} \]

\[ V_{T2} = V_{DD} - \frac{I_X}{q_{m4}} = V_{T1} \left( \frac{1}{r_{o3}} + q_{m1} \right) \]

\[ = I_X R + \left[ \frac{1}{r_{o3}} - q_{m2} \left( \frac{1}{r_{o3}} - q_{m2} \right) \right] R_{T2} \]

So \( V_{DD} - \frac{I_X}{q_{m4}} = \)

\[ I_X R + I_X R_{T2} - q_{m2} R_{T2} V_{T1} + q_{m2} R_{T2} L_{X} R \]

\[ V_{DD} = I_X \left( R + R_{T2} + q_{m2} R_{T2} R + \frac{1}{q_{m4}} \right) - \frac{q_{m2} R_{T2} \left( I_X + \frac{V_{DD}}{\frac{1}{r_{o3}}} \right)}{\frac{1}{r_{o3}} + \frac{1}{q_{m4}}} \]

Assume \( R_{T2} \approx R_{o3} \)

\[ \frac{I_{BIAS}}{V_{DD}} = \frac{I_X}{V_{DD}} \approx \frac{1 + \frac{q_{m2}}{q_{m1}}}{q_{m2} R_{T2} R} \]

The use of cascodes on the top and bottom would reduce \( \frac{I_{BIAS}}{V_{DD}} \) by another factor of \( q_{m1} \).