Consider bottom NMOS half

Equivalent Small-Signal Circuit w/ noise sources

From KCL at V_a:

\[ V_a = (i_{n,\text{out}} - i_{n,\text{MN}}) R_n \]

KCL at V_{\text{out}+}:

\[ i_{n,\text{out}} = i_{n,\text{MN}} - g_m (i_{n,\text{out}} - i_{n,\text{MN}}) R_n \]

\[ i_{n,\text{out}} (1 + g_m R_n) = i_{n,\text{MN}} + g_m R_n i_{n,\text{IN}} \]

\[ i_{n,\text{out}} = \frac{i_{n,\text{MN}}}{1 + g_m R_n} + \frac{g_m R_n i_{n,\text{IN}}}{1 + g_m R_n} \]

w/ statistically independent noise sources

\[ i_{n,\text{out}}^2 = \frac{i_{n,\text{MN}}^2}{(1 + g_m R_n)^2} + \left( \frac{g_m R_n}{1 + g_m R_n} \right)^2 i_{n,\text{IN}}^2 R_n \]

where \( i_{n,\text{MN}}^2 = \frac{\theta}{3} kT g_m \) and \( i_{n,\text{IN}}^2 R_n = \frac{2 e KT}{R_n} \)
The top PMOS half can be analyzed in a similar manner to yield the total $i_{in, out}^2$

$$i_{in, out}^2 = \frac{i_{in, mn}^2}{(1+\gamma_m R_N)^2} + \left(\frac{g_{mn} R_N}{1+\gamma_m R_N}\right)^2 i_{n, R_N}^2 + \frac{i_{n, mp}^2}{(1+\gamma_p R_p)^2} + \left(\frac{g_{mp} R_p}{1+\gamma_p R_p}\right)^2 i_{n, R_p}^2$$

Where $i_{n, mn}^2 = \frac{8}{3} kT \gamma_m$, $i_{n, mp}^2 = \frac{8}{3} kT \gamma_p$

$$i_{n, R_N}^2 = \frac{4kT}{R_N} \quad \quad i_{n, R_p}^2 = \frac{4kT}{R_p}$$

The input referred voltage noise can be computed as

$$\mathcal{V}_{n, in}^2 = \frac{i_{in, out}^2}{G_m^2}$$

Where $G_m = \frac{g_{mn}}{1+\gamma_m R_N} + \frac{g_{mp}}{1+\gamma_p R_p}$