EE240B HW 2

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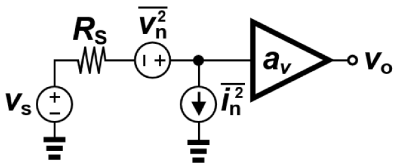
1 Electronic Noise



Noise source	Amplifier A	Amplifier B
$\sqrt{\frac{\overline{v_n^2}}{\Delta f}}$	$1\frac{\text{nV}}{\sqrt{\text{Hz}}}$	$10\frac{\text{nV}}{\sqrt{\text{Hz}}}$
$\sqrt{\frac{\overline{i_n^2}}{\Delta f}}$	$1\frac{\text{pA}}{\sqrt{\text{Hz}}}$	$1\frac{\text{fA}}{\sqrt{\text{Hz}}}$

(a) Calculate the input referred noise in $V/\sqrt{\text{Hz}}$ achieved with the two amplifiers for $R_S = 50\Omega, 5\text{M}\Omega$. Only consider the amplifier noise. Assume the amplifier voltage and current sources are uncorrelated.

R_s	Amplifier A	Amplifier B
50 Ω	$1.05\frac{\text{nV}}{\sqrt{\text{Hz}}}$	$10\frac{\text{nV}}{\sqrt{\text{Hz}}}$
5 MΩ	$5000\frac{\text{nV}}{\sqrt{\text{Hz}}}$	$15\frac{\text{nV}}{\sqrt{\text{Hz}}}$

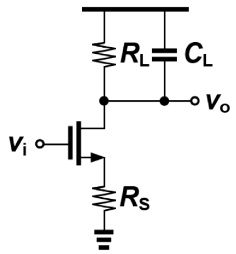
(b) Significance of the result?

If the input voltage source's resistance is low, an amplifier with low voltage noise should be chosen (since the amplifier's current noise won't see a large resistance). Use a BJT op-amp.

If the input voltage source's resistance is high, an amplifier with low current noise should be chosen. This is usually a FET op-amp.

2 Amplifier Noise

Derive analytical expressions as a function of $g_m, \gamma, f_T, R_L, R_S$, and C_L



(a) The voltage gain $a_v(s) = v_o/v_i$

This is a standard source-degenerated common-source amplifier with a complex load.

$$Z_L = (R_L||C_L) = (R_L||\frac{1}{sC_L}) = \frac{R_L}{a + sR_LC_L}$$

$$a_v(s) =$$