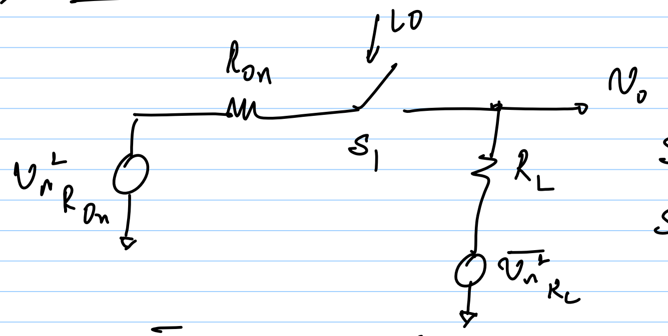
4/10/13

Lec 27

Passive Mixer Noise Analysis

1) RZ PM



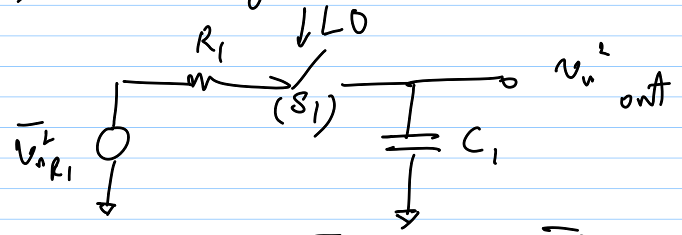
S_1 on $- 4kT(R_{on}||R_L)$

S_1 off $- 4kT R_L$

$$\overline{v_{on}^2} \approx 2kT\left(R_L + R_{on}||R_L\right) \; ; \; G_c = \frac{1}{\pi}$$

$$\overline{v_{n,in}^2} = 2\pi^2 kT\left(R_L + R_{on}||R_L\right)$$

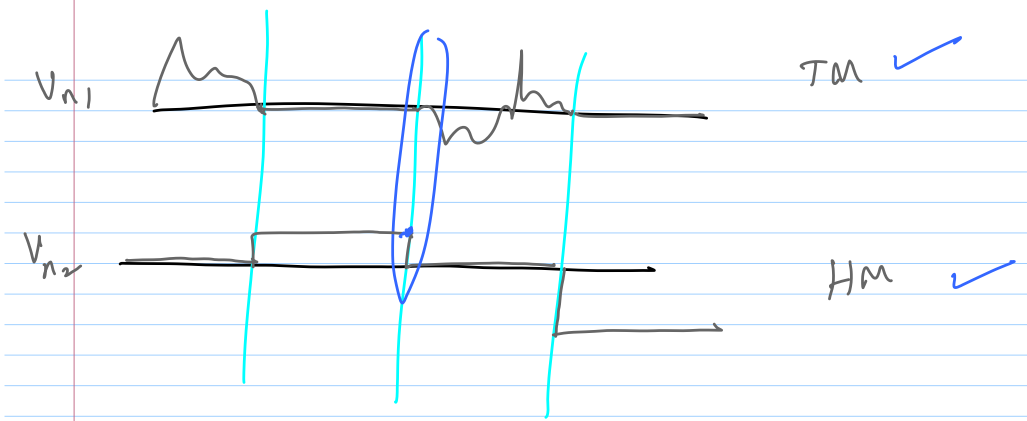
2) Sampling PM



without S_1 : $\overline{v_n^2}_{LPF} = \overline{v_{nR_1}^2} \cdot \dfrac{1}{1+(R_1 C_1 w)^2}$

With S_1 : S_1 ON $-$ $\overline{v_{n\,out}^2} = v_n^2{}_{LPF}$ (Track mode)

S_1 off $-$ hold noise on cap. (hold mode)



* Separate into TM & HM
* V_{n1} & V_{n2} are partially correlated

(I) Correlation

a) Enter track mode: $-$ previous sample value held $\Rightarrow$ takes some time to discharge $-$ negligible because of low τ when S_1 is on

b) Enter HM $-$

- noise components far below f_{LO} remain constant
- 0 to $\frac{f_{LO}}{10}$ appear @ o/p
- $2kTR_1$ for $0 < f < f_{LO}$

(I) V_{n_1}' — V_{n_1} components above $\frac{f_{LO}}{10}$

$$V_{n_1}'(t) = V_{LPF}(t) \times S(t)$$

$$V_{n_1}'(f) = V_{LPF}(f) * S(f)$$

Impulse train, with sinc envelope

If $\frac{1}{R_1C_1} << 3\omega_{LO}$

$$\overline{V_{n_1}'^2}(f) = 2\left(\frac{1}{\pi^2} + \frac{1}{9\pi^2}\right) \cdot \frac{2kTR_1}{1+(2\pi R_1 C_1 f)^2}$$

+ve & −ve freq components; 1st & 3rd terms of $S(f)$; $\overline{V^2_{n,LPF}}$

@ low output freq.

$$\overline{V_{n_1}'^2} = 0.226\,(2kTR_1) \quad \text{one-sided}$$

(II) $V_{n_2}' = (V_{n,LPF}(t) \times \text{Impulse train}) * \text{sq. pulse}$

→ aliasing of noise around $\pm k f_{LO}$

$$\overline{V'_{n,alias}} = 2 \times \frac{2kTR_1}{T_{LO}^2} \sum_{n=1}^{\infty} \frac{1}{1+a^2n^2}$$

$$a = 2\pi R_1 C_1 f_{LO}$$

$$\overline{V_{n_2}'} = \overline{V'_{n,alias}} \times \text{sinc envelope}$$

$$\overline{V_n'^2}(f) = kT\left(\frac{1}{4C_1 f_{LO}} - \frac{R_1}{2}\right)$$

$$\overline{V^2_{n_{out}}} = kT\left(3.9R_1 + \frac{1}{2C_1 f_{LO}}\right)$$

$$G_c^2 = \frac{1}{\pi^2} + \frac{1}{4}$$

$$\overline{V^2_{n,in}} = 2.85\,kT\left(3.9R_1 + \frac{1}{2C_1 f_{LO}}\right)$$

Follow Section 6.2.3 in Razavi's Textbook