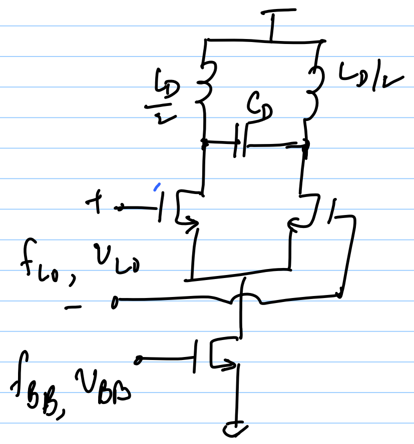
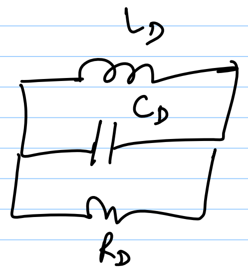
25/9/13

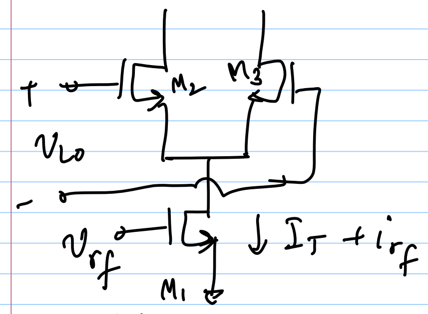
Lec 23

V-C mixer

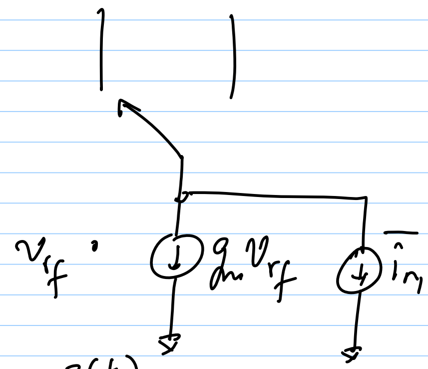




2) Noise from g_m-stage

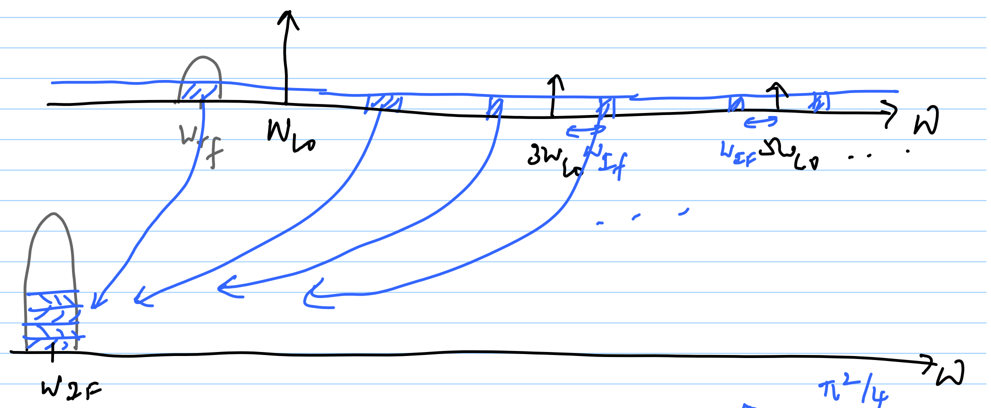


$\equiv$



* $\overline{i_{n_1}}$ gets modulated by $s(t)$

a) thermal noise

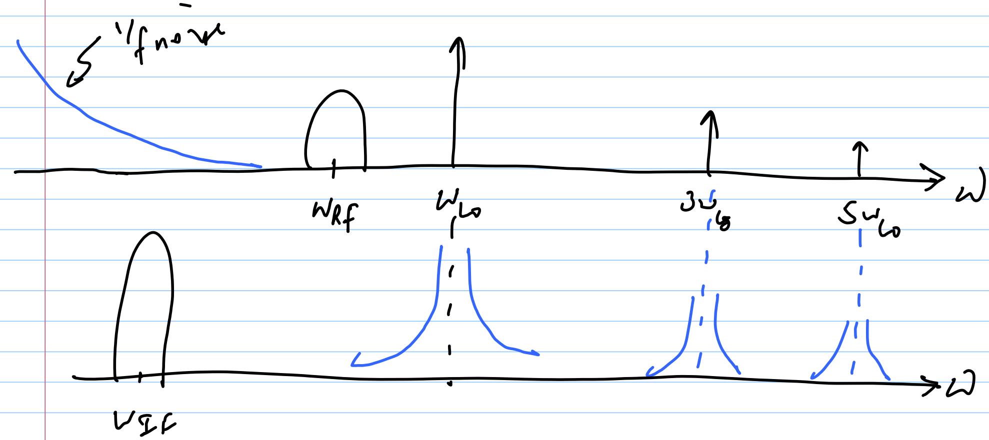


$$\frac{\overline{v_{on_{gm}}^2}}{\Delta f} = \frac{4kT\gamma}{g_m} \times \left(\frac{2}{\pi} g_m R_L\right)^2 \times \left(1+\frac{1}{3^2}+\frac{1}{5^2}+\dots\right)$$

$\pi^2/4$, $\times 2$

$$\frac{\overline{v_{on_{gm}}^2}}{\Delta f} = 4kT\gamma g_m R_L^2$$

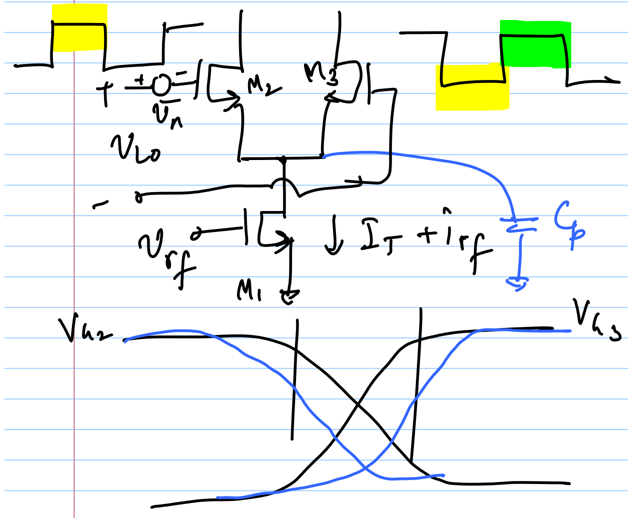
b) 1/f noise



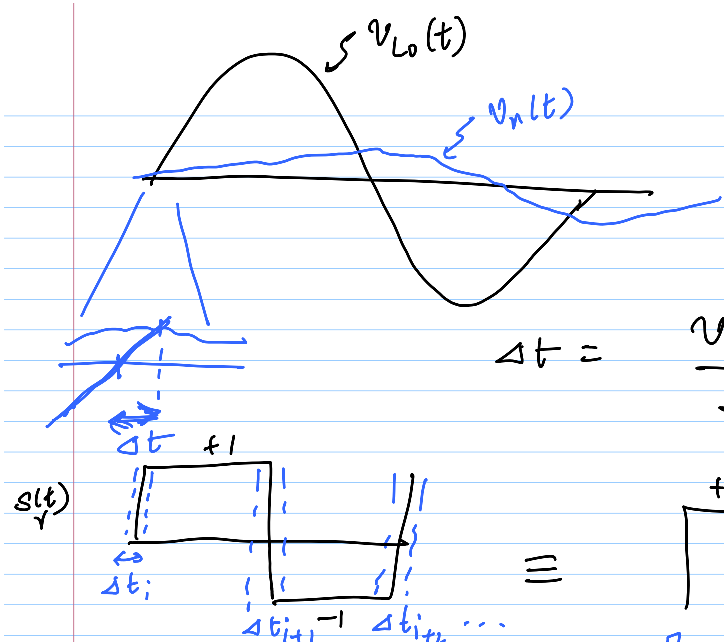
* for Rx mixers – 1/f noise is not a big issue as long as symmetry is preserved

* In Tx mixer – 1/f noise gets upconverted to RF

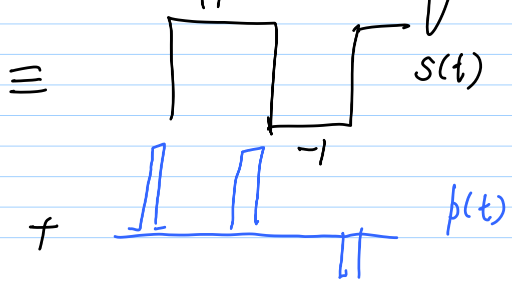
3) Noise from switching pair



$\overline{v_n}$ = noise of M_2/M_3 referred to LO port



$\Delta t = \frac{v_n(t)}{S}$ ← slope @ switching instant



$s_r(t) = s(t) + p(t)$

$p_r(t)$ = output current pulse train of height $2I_T$

@ rate $2f_{LO}$

width $\Delta t = \frac{v_n(t)}{S}$

$v_{LO}(t) = \pm V_{LO}\sin\omega_{LO}t \Rightarrow v_{LOd}(t) = 2V_{LO}\sin\omega_{LO}t$

$\Rightarrow$ slope $= \frac{dv_{LOd}}{dt} = 2V_{LO}\cdot\omega_{LO}\cos\omega_{LO}t$

$S = 2V_{LO}\cdot\omega_{LO}$

avg. value of I_{out} over one period:

$$\bar{I}_{o_n} = \frac{2}{T_{LO}} \times 2 I_T \times \Delta t$$

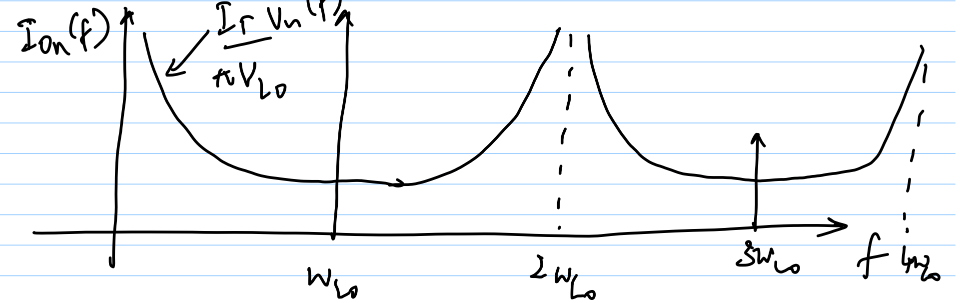
$$= \frac{4 I_T \cdot V_n}{S T_{LO}}$$

$$= \frac{4 I_T V_n}{4\pi V_{LO}} = \frac{I_T}{\pi V_{LO}} \cdot V_n$$

$$I_{on}(f) = \frac{1}{\pi} \cdot \frac{I_T}{V_{LO}} \cdot V_n(f)$$

, except you have sampled images @ $2f_{LO}$

Flicker noise



$$I_{nout}(t) = \sum_{k=-\infty}^{\infty} \frac{2 I_T}{S} V_n(t) \cdot \delta\left(t - \frac{k T_{LO}}{2}\right)$$

$$I_{nout}(f) = \frac{4 I_T}{S T_{LO}} \sum_{k=-\infty}^{\infty} V_n(f)\, \delta(f - 2k f_{LO})$$