HA-4

30/10/2024

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① Characteristics of Noise,

* If the signal is Random in Nature, the average power in time domain,

$$P_{avg} = \frac{1}{T}\int_{-T/2}^{T/2} \frac{x^2(t)}{R_L}$$

In frequency domain,

PSD – power spectral density, where the average power at every 1Hz value. The amplitude distribution is given according to gaussian distribution,

$$P_x x(f) = \frac{1}{\sigma\sqrt{2\pi}} \exp \frac{-(x-m)^2}{\sigma^2}$$

σ – variance, m – mean

for standard guassian, mean = 0

then,

$$P_x x(f) = \frac{1}{\sigma\sqrt{2\pi}} \exp \frac{-x^2}{\sigma^2}$$

if the signal is deterministic in nature,

Average power in time domain,

$$P_{avg} = \lim_{T\to\infty} \frac{1}{T}\int_{-T/2}^{T/2} \frac{x^2(t)}{R_L} dt$$

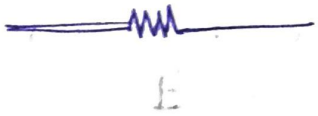
if it depends on R_L units are $\frac{\text{watts}}{\text{Hz}}$

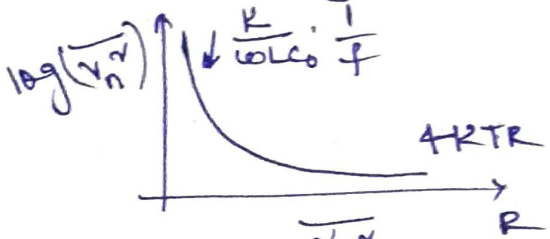
Otherwise, $\frac{V^2}{\text{Hz}}$

(2) Types of Noise,

* Thermal Noise,

the Noise is generated due to temperature changes leads to atomic vibrations. This kind of Noise can seen mainly in Resistors, which is primary source of Noise.

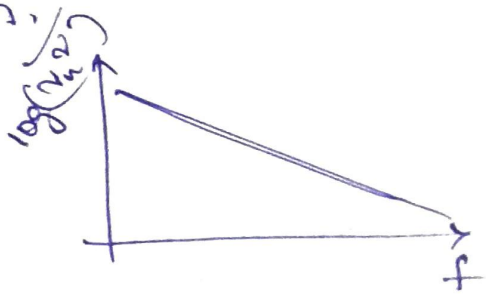




* flicker Noise,

the Noise is occured due to Dangling bonds at silicon layer at gate terminal. where the electron suddenly occupies the energy & leaves. due to this transition noise occurs. this process happens, when low frequency is given.

$$\overline{v_n^2}_{1/f} = \frac{K}{WL \cdot C_{ox}} \cdot \frac{1}{f}$$

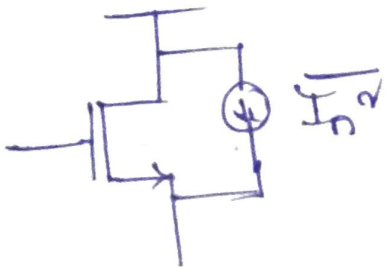


* MOSFET ($\overline{I_n^2}$),

$$\overline{I_n^2} = 4KT\gamma g_m$$

$\gamma = \frac{2}{3} \longrightarrow$ long channel

$\gamma \approx 1 \longrightarrow$ short channel



$$\overline{I_n^2} = \frac{4KT}{R}$$