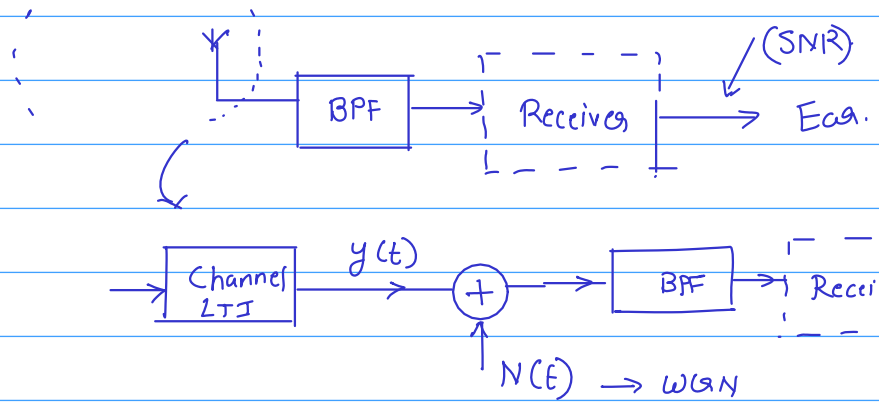
Noise models for commn. receivers.



Additive white Gaussian noise (AWGN)

At the o/p where does this random noise come from?

1) from the input (spectrum) 2) generated internally

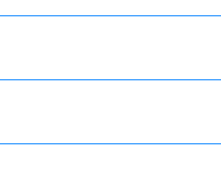
a) interference due to other transmitters
b) background radiation (cosmic radiation)
c) electrical equipment (EMI)

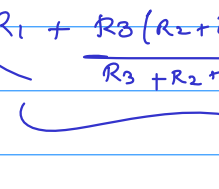
a) Thermal noise
b) Shot noise

→ Johnson-Nyquist / Johnson noise

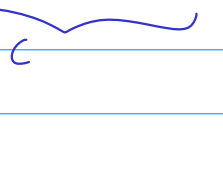
Assume internal noise dominates: Thermal and shot noise.

kept at T K.





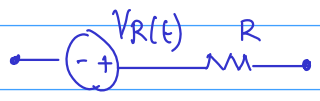
avg of $V_R^2(t)$

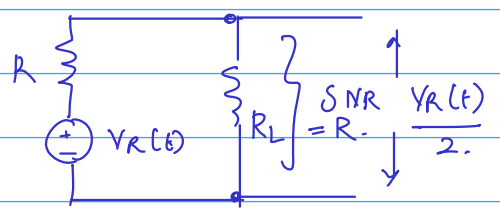


$\approx 4RKT\Delta$

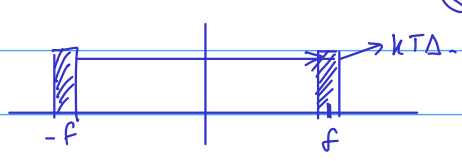
Independent of f.

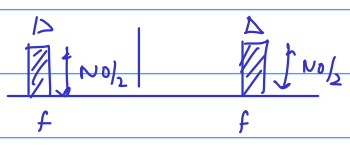
assume $\mathbb{E}\, V_R^2(t) = 4RKT\Delta$

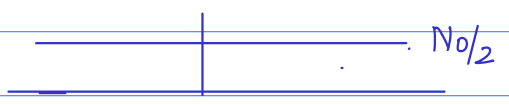




The worst case power is $(KT\Delta)$.



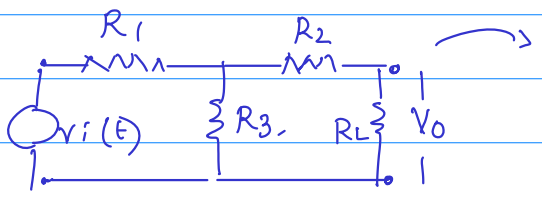


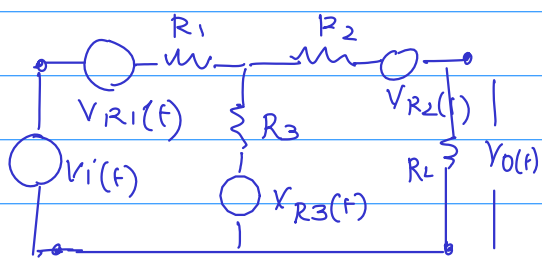


$N_0/2 \times \Delta \times 2 = KT\Delta$

$N_0 = KT$

Shot noise is also modelled as being white.





$$V_0(t) = V_i(t) \cdot \underbrace{\left(\frac{\left(\frac{R_3 \cdot (R_2 + R_L)}{R_3 + R_2 + R_L}\right)}{R_1 + \frac{R_3(R_2+R_L)}{R_3+R_2+R_L}}\right)}_{C} \cdot \left(\frac{R_L}{R_2 + R_L}\right) + \alpha_1 \cdot V_{R_1}(t) + \alpha_2 V_{R_2}(t) + \alpha_3 V_{R_3}(t)$$

w/o noise voltage sources:

$$V_0(t) = V_i(t) \cdot (C)$$

H/W can these noise voltages be seen as coming from the input instead of being generated internally?

Theoretical motivation for Gaussian nature:

comes from central limit theorem:

$(X_1, X_2 \dots X_n) \rightarrow$ IID

$$S_n = \left(\frac{\sum_1 X_i - n\,\mathbb{E}X_1}{\sqrt{n\,\mathrm{var}(X_1)}}\right) \sim N(0,1)$$

Classtest 3 on 30/10/2019.