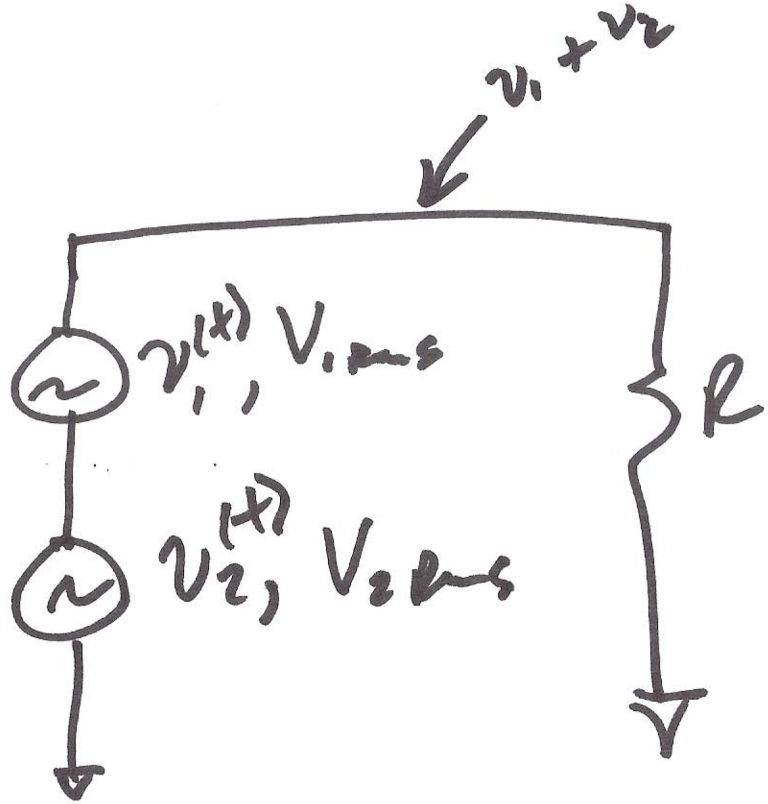
$$P_{AVG} = \frac{V_{1RMS}^2 + V_{2RMS}^2}{R} = \frac{V_{1RMS}^2}{R} + \frac{V_{2RMS}^2}{R}$$



$$v_1(t) = V_p \sin(2\pi f t)$$

$$v_2(t) = -V_p \sin(2\pi f t)$$

$$v(t) = v_1(t) + v_2(t)$$

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$$P_{INST}(t) = \frac{v^2(t)}{R} = \frac{[v_1(t) + v_2(t)]^2}{R}$$

$$= \frac{v_1^2(t)}{R} + \frac{v_2^2(t)}{R} + \frac{2v_1(t)v_2(t)}{R}$$

$$P_{AVG} = \frac{V_{RMS}^2}{R} = \frac{1}{T_{meas}} \int_0^{T_{meas}} \frac{v^2(t)}{R} \cdot dt$$

No correlation between v_1 & v_2

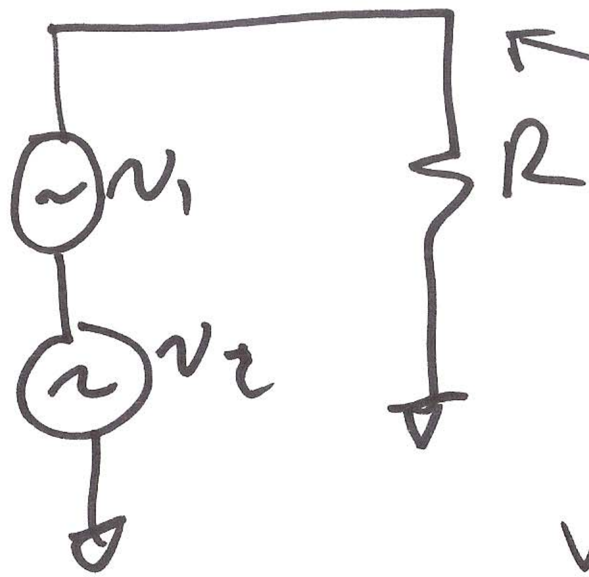
$$P_{AVG} = \lim_{T \to \infty} \frac{1}{T_{meas}} \int_0^{\infty} \frac{2v_1(t)v_2(t)}{R} dt = 0$$

2)

Simple example

$$v_1(t) = v_2(t) = V_p \cdot \sin(2\pi f \cdot t)$$

$$V_{1,rms} = V_{2,rms} = \frac{V_p}{\sqrt{2}}$$



$$2V_p \sin(2\pi f \cdot t)$$

$$V_{rms} = \frac{2V_p}{\sqrt{2}}$$

$$P_{AVG} = \frac{V_p^2/2}{R} + \frac{V_p^2/2}{R} + \frac{2 \cdot V_p/\sqrt{2} \cdot \frac{V_p}{\sqrt{2}}}{R}$$

$$\frac{\left(\frac{2V_p}{\sqrt{2}}\right)^2}{R} = \frac{V_p^2}{2R} + \frac{V_p^2}{2R} + \underbrace{\frac{2V_p^2}{2R}}_{\text{100\% correlation}}$$

$$\frac{2V_p^2}{R} = \frac{4V_p^2}{2R} = \frac{2V_p^2}{R}$$

Another example

$$v_1(t) = V_p \sin 2\pi f \cdot t$$

$$v_2(t) = -V_p \sin 2\pi f \cdot t$$

$$\frac{2V_p^2}{R} = \frac{V_p^2}{2R} + \frac{V_p^2}{2R} - \overbrace{\frac{2V_p^2}{2R}}^{-100\%\ \text{correlation}}$$

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$$V_{1,rms}^2 + V_{2,rms}^2 + 2C\, V_{1\,rms} V_{2\,rms}$$

$$-1 \le C \le 1$$

↑ same freq.
diff. amplitudes
and phase-shifts

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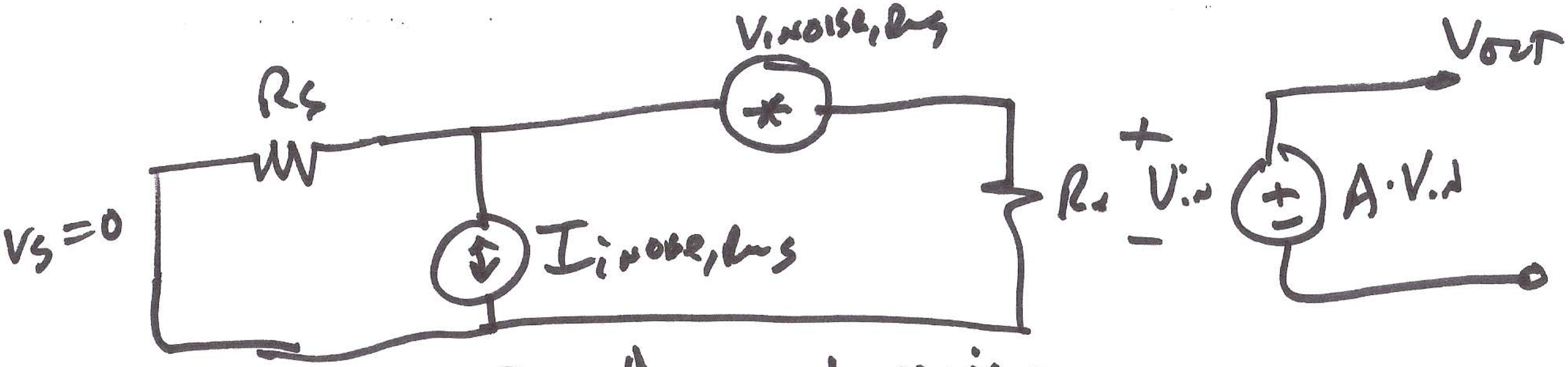
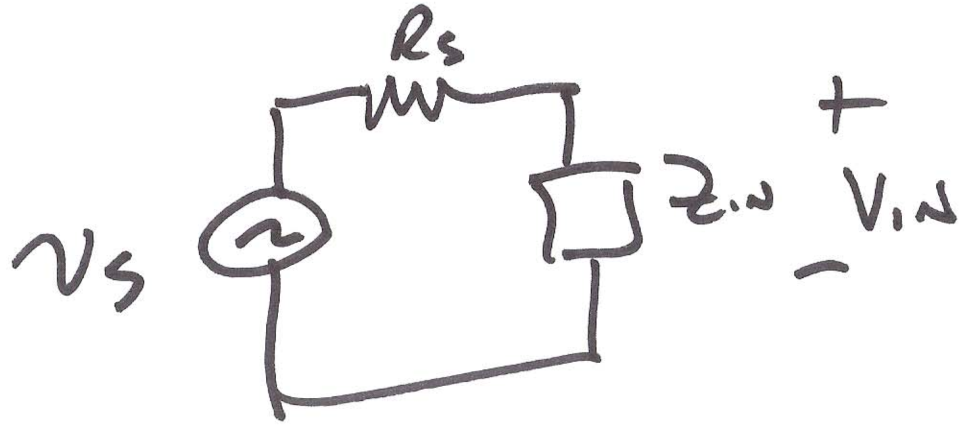


Neglecting R_S thermal noise

$$V^2_{onoise,rms} = \left(\frac{AR_{in}}{R_S + R_{in}}\right)^2 \left(V_{inoise,rms} + I_{inoise,rms}\right)^2$$

$$= \left(\frac{AR_{in}}{R_S + R_{in}}\right)^2 \left(V^2_{inoise,rms} + I^2_{inoise,rms} R_S^2 + 2C\, V_{inoise} \cdot I_{inoise,rms} \cdot R_S\right)$$

Complex input impedance



$$\frac{R_{IN}}{R_{IN}+R_S} \rightarrow \frac{Z_{IN}}{R_S+Z_{IN}}$$

$$Z_{IN} = \frac{1}{j\omega C} = \frac{-j}{\omega C}$$

$$|V_{IN}|^2 = |V_S|^2 = \frac{|Z_{IN}|^2}{|R_S+Z_{IN}|^2}$$

point Always take magnitude prior to squaring optimum source resistance

$$R_{s,opt} = R_{in}$$

$$R_{s,opt} = |Z_{in}|$$

$$Z_{in} = R_{in} + jX_{in}$$

$$R_{s,opt} = \sqrt{R_{in}^2 + X_{in}^2}$$