Section 8.1

Noise

→ 1) Inherent Noise

thermal
flicker noise
shot noise

discrete charge movement
trapping / releasing at various times

etc.

2) Coupled Noise

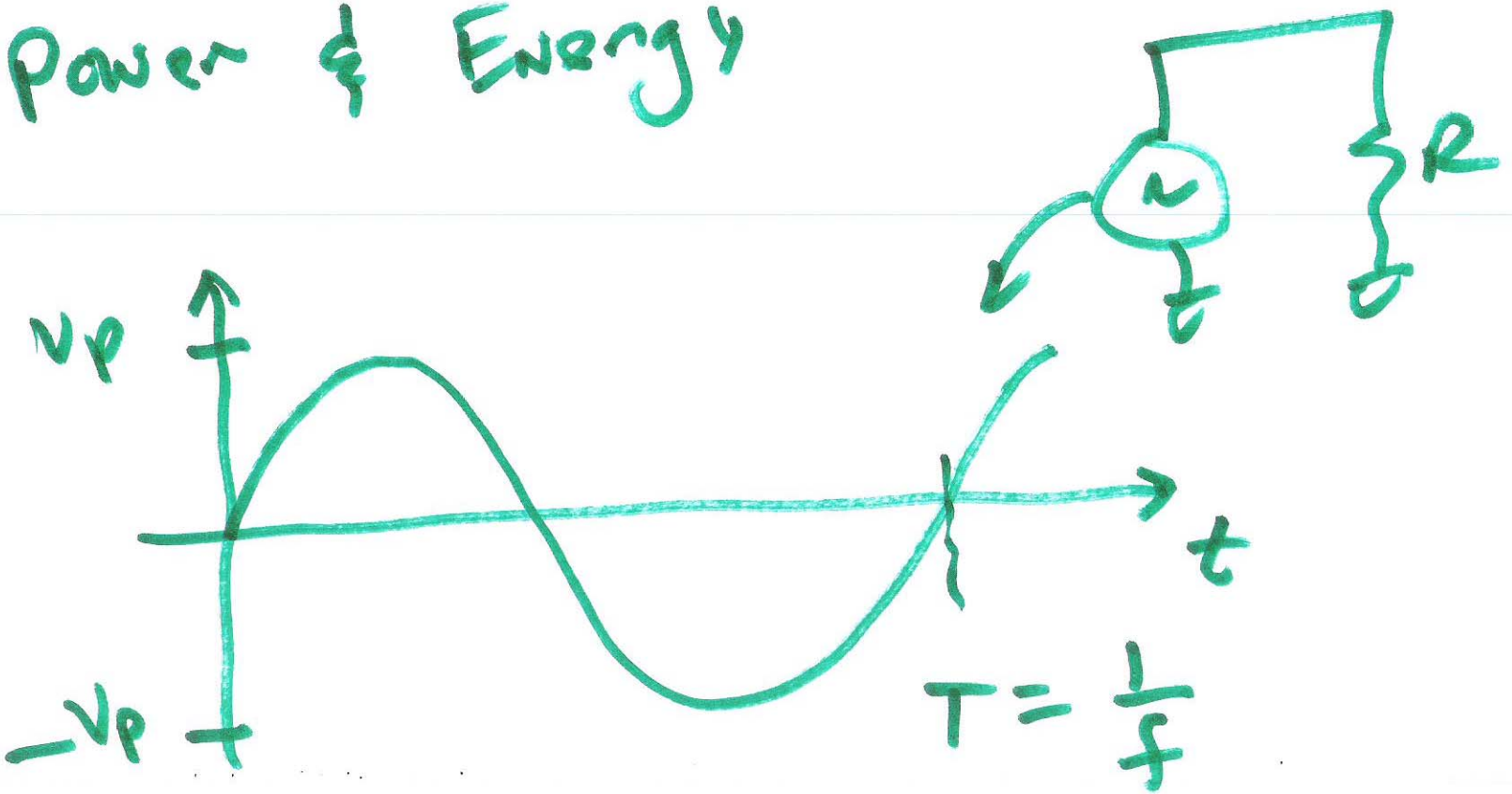
$\frac{V^2}{Hz}$

3) Quantization Noise

Analog → digital signal

1)

Power & Energy



instantaneous power

$$P_{inst}(t) = \frac{V_p^2 \sin^2\left(2\pi \frac{t}{T}\right)}{R}$$

$$\text{Energy} = \int_0^{\infty} \frac{V_p^2 \sin^2\left(2\pi \frac{t}{T}\right)}{R} \cdot dt$$

Average Power = P_{AVG} =

$$\frac{1}{T}\int_0^T \frac{V_p^2 \sin^2\left(2\pi \frac{t}{T}\right)}{R} \cdot dt$$

$$P_{AVG} = \frac{\bar{V}^2}{R}$$ ← mean-squared voltage

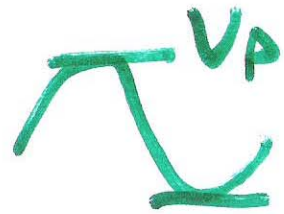
mean-squared voltage $= \bar{V}^2 = \frac{1}{T}\int_0^T V_p^2 \sin^2\left(2\pi \cdot \frac{t}{T}\right) \cdot dt$

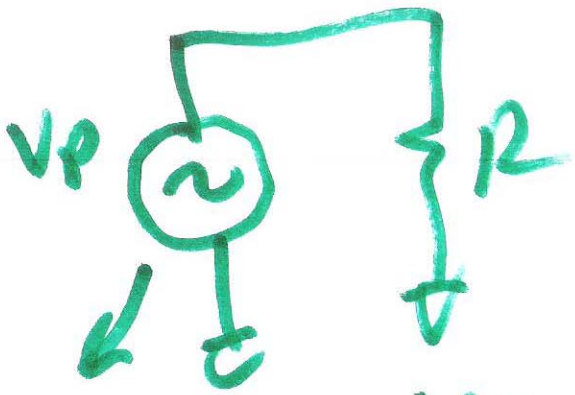
$$\boxed{V_1^2 = \frac{V_p^2}{2}}$$

3)

Root Mean Squared, Rms

$$V_{Rms} = \sqrt{\overline{V^2}} = \frac{V_p}{\sqrt{2}}$$





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

$$P_{AVG} = \frac{V_{Rms}^2}{R}$$

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

$$\Rightarrow \frac{V_{DC}^2}{R} \Rightarrow$$

120V Rms

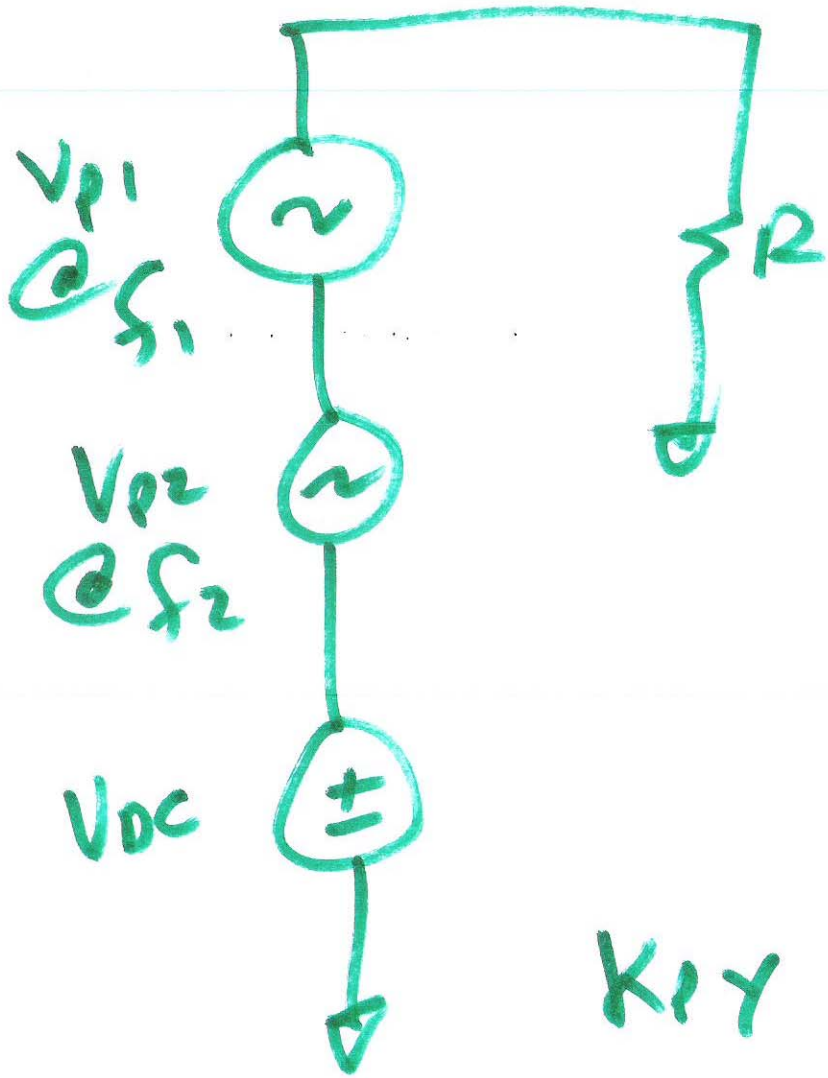
$$V_p = \sqrt{2} \cdot 120$$

$$V_p - V_p = 2V_p$$

$$= \frac{1}{2} \cdot 2 \cdot \sqrt{2} \cdot V_p$$

$$\boxed{V_{DC} = V_{Rms}}$$

Same power



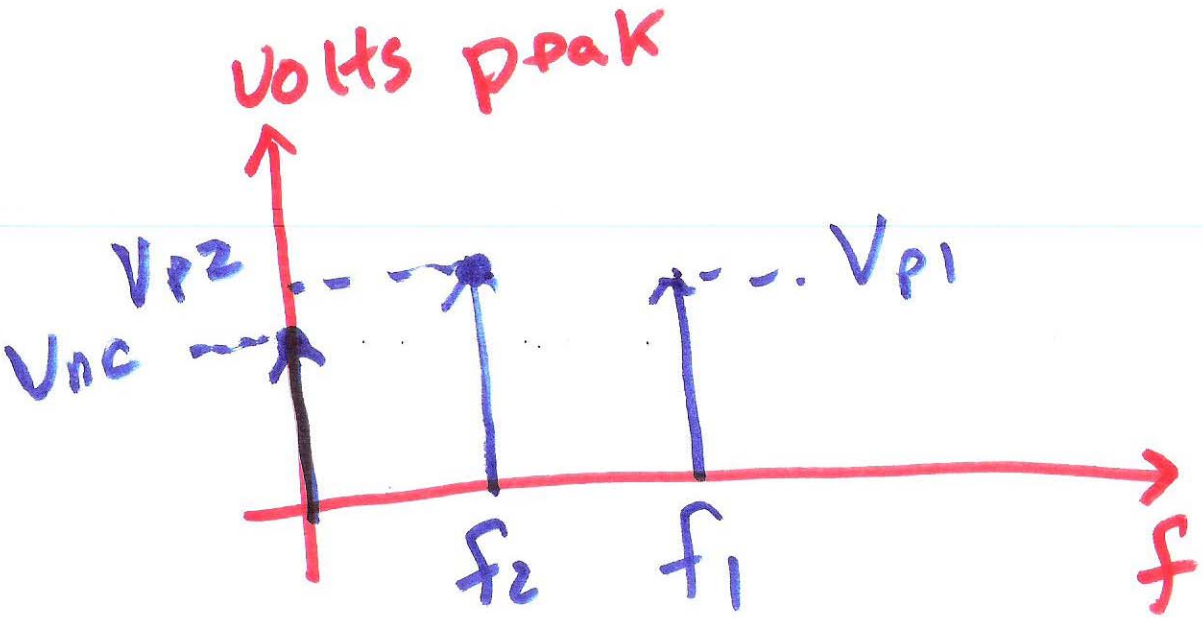
$$P_{AVG} = \frac{\frac{V_{p1}^2}{2} + \frac{V_{p2}^2}{2} + V_{DC}^2}{R}$$

$$= \frac{V_{rms1}^2 + V_{rms2}^2 + V_{DC}^2}{R}$$

Key point is
we sum power!

Never sum rms voltages

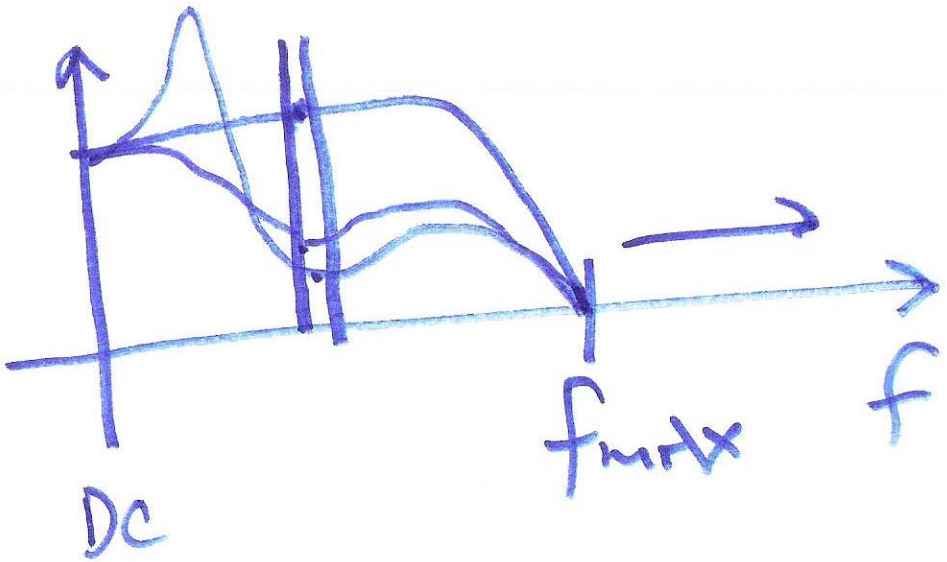
5)



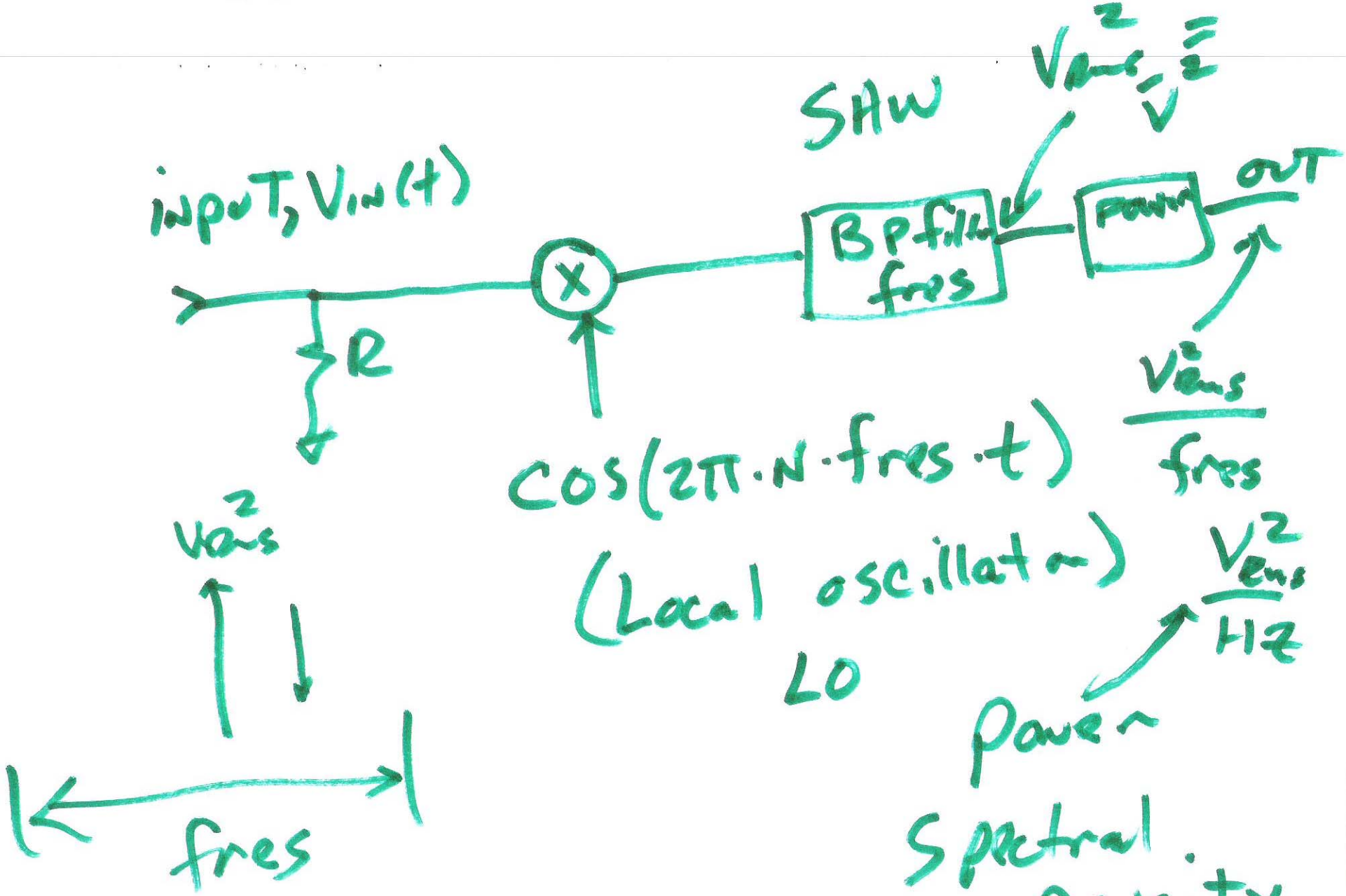
$$V_{rms} = \sqrt{\bar{V}^2}$$

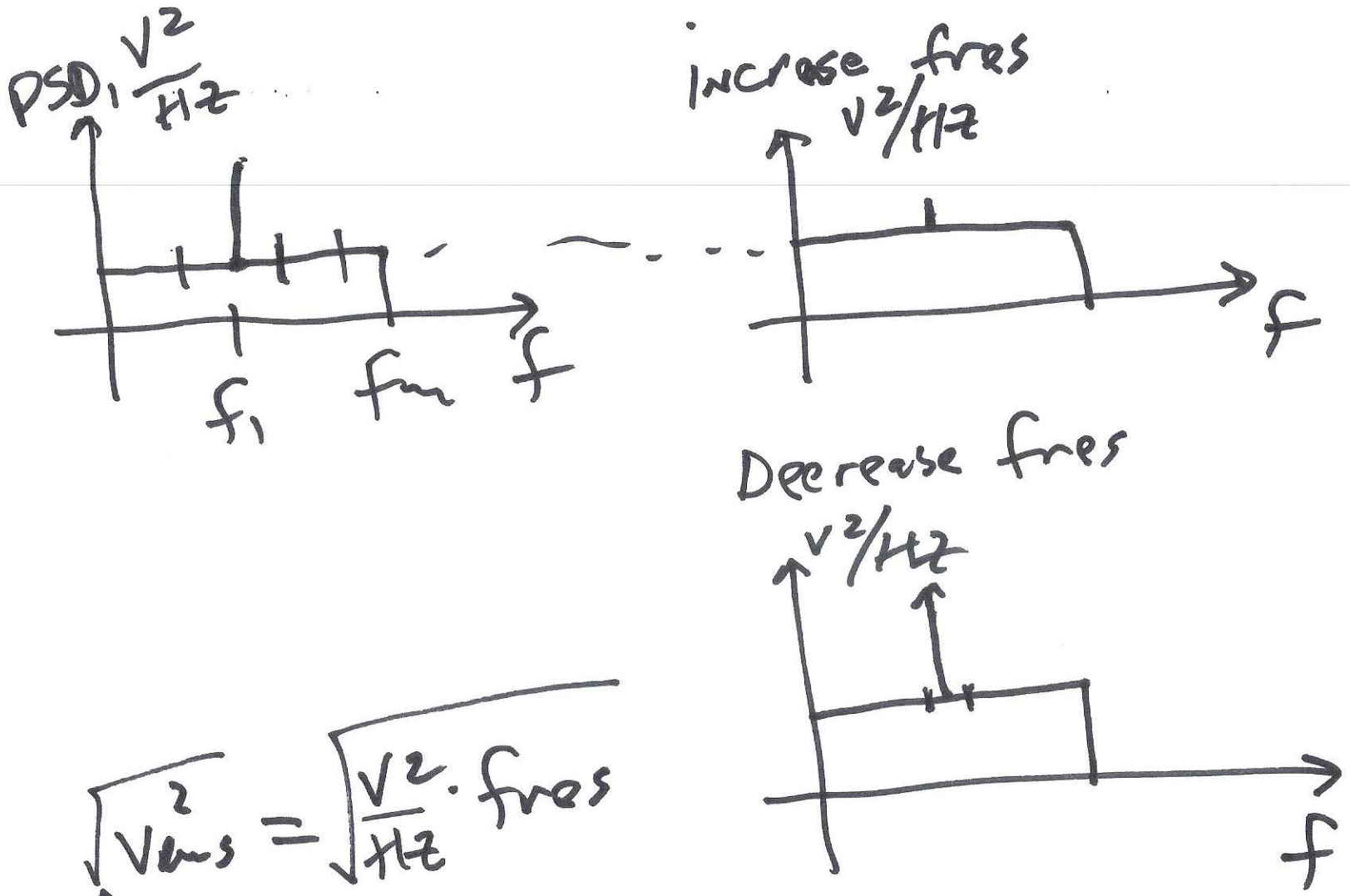
$$\Downarrow$$

$$\frac{V_{rms}^2}{Hz} = \frac{\bar{V}^2}{Hz}$$

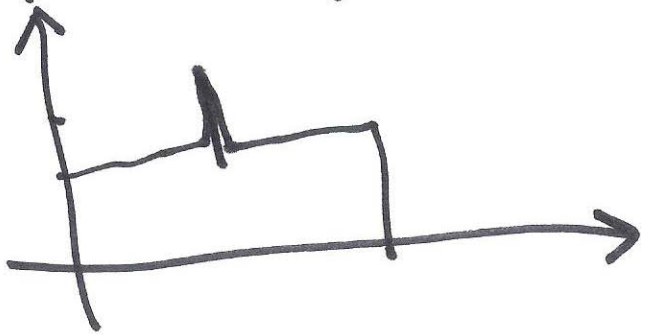


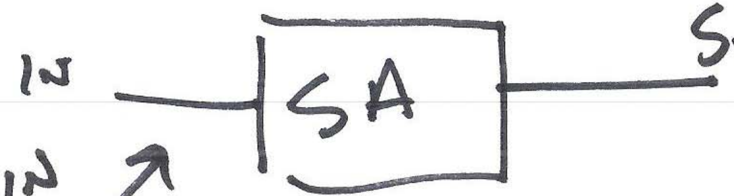
Spectrum Analyzer, SA





$$\sqrt{V_{rms}^2} = \sqrt{\frac{V^2}{Hz} \cdot fres}$$





$0 \rightarrow 100 \rightarrow 200$

$0 \le N \le 100$, 101 points

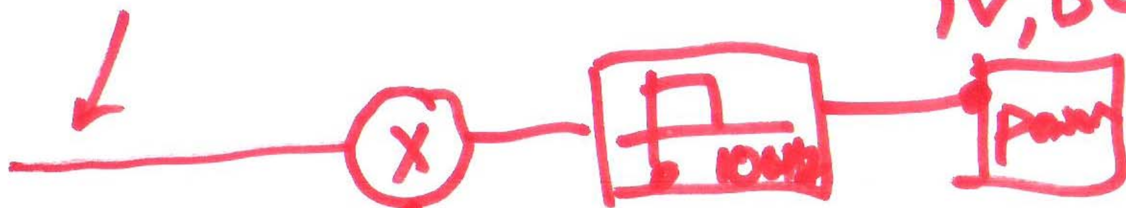
$0 \rightarrow 100$

1V + IN

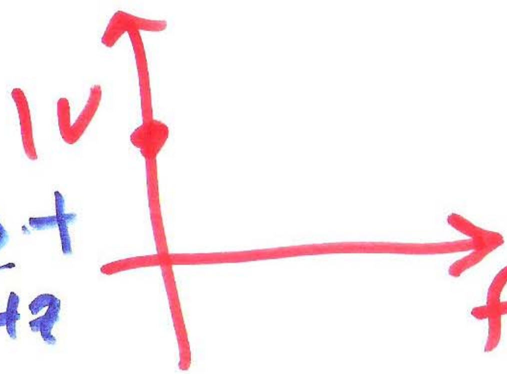
$\sin[2\pi \, 4.05\,\text{KHz} \cdot t]$

$0 \rightarrow 10\,\text{KHz}$

$f_{res} = 100\,\text{Hz}$

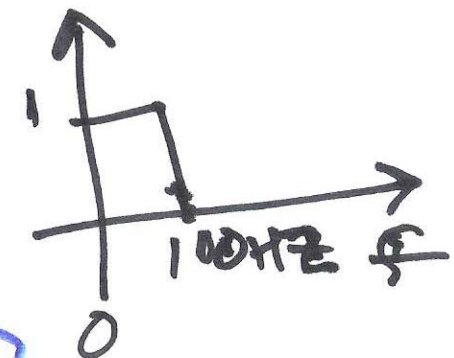


B.P. filter



$0 \rightarrow 100\,\text{Hz}$

DC



$N = 0 \Rightarrow 1$

$N = 1 \quad \cos 2\pi 100 \cdot t$

(4)KHz

$$\cos A \cdot \sin B = \frac{1}{2}\left[\sin[B-A] + \sin[A+B]\right]$$

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9)

N.fres = 4KHz

39:01

$\cos(2\pi \cdot 4K t) \cdot (1 + \sin(2\pi\, 4.05K t))$

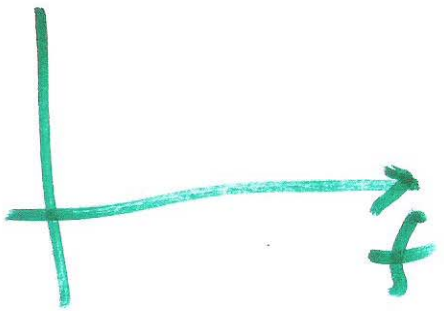
$\cos 2\pi \cdot 4K \cdot t$ + @ 50 Hz, @ 150 Hz

N.fres = 4.1 KHz

− 50

power spectral, PSD

$\sqrt{2} \cdot \sqrt{fres \frac{V^2}{Hz}}$



10)