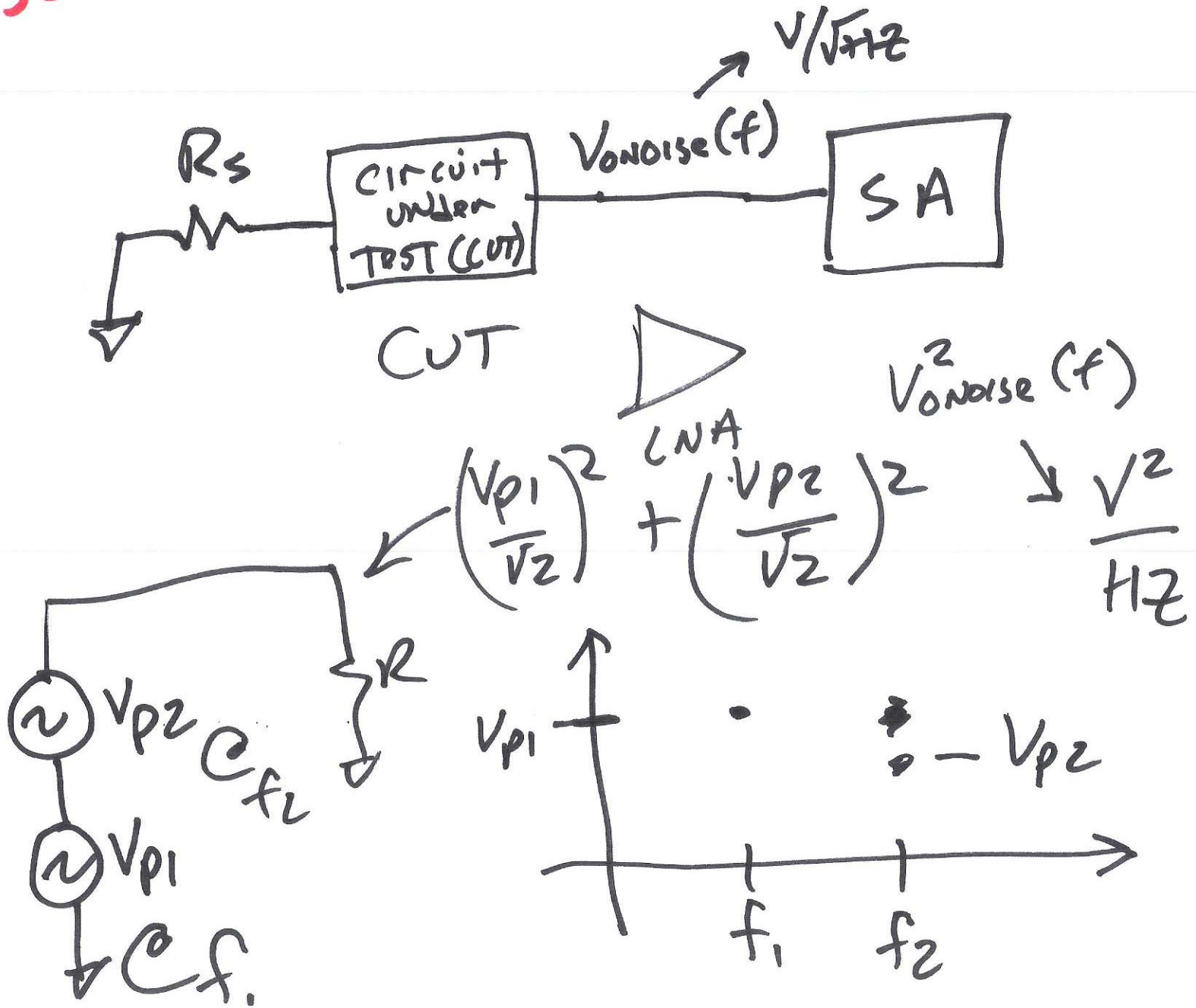
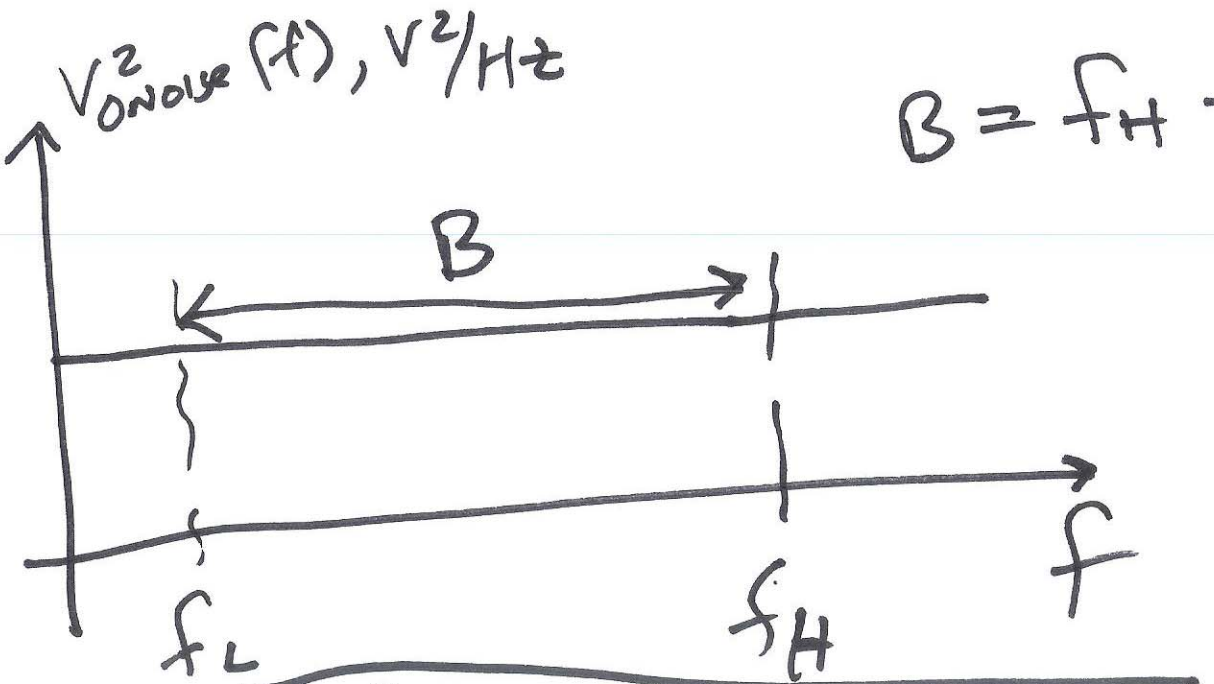
Section 8.2 CIRCUIT NOISE



1)



$$B = f_H - f_L$$

$$\sqrt{\overline{V^2}} = V_{RMS} = \sqrt{\int_{f_L}^{f_H} V^2_{ONOISE}(f) \cdot df}$$

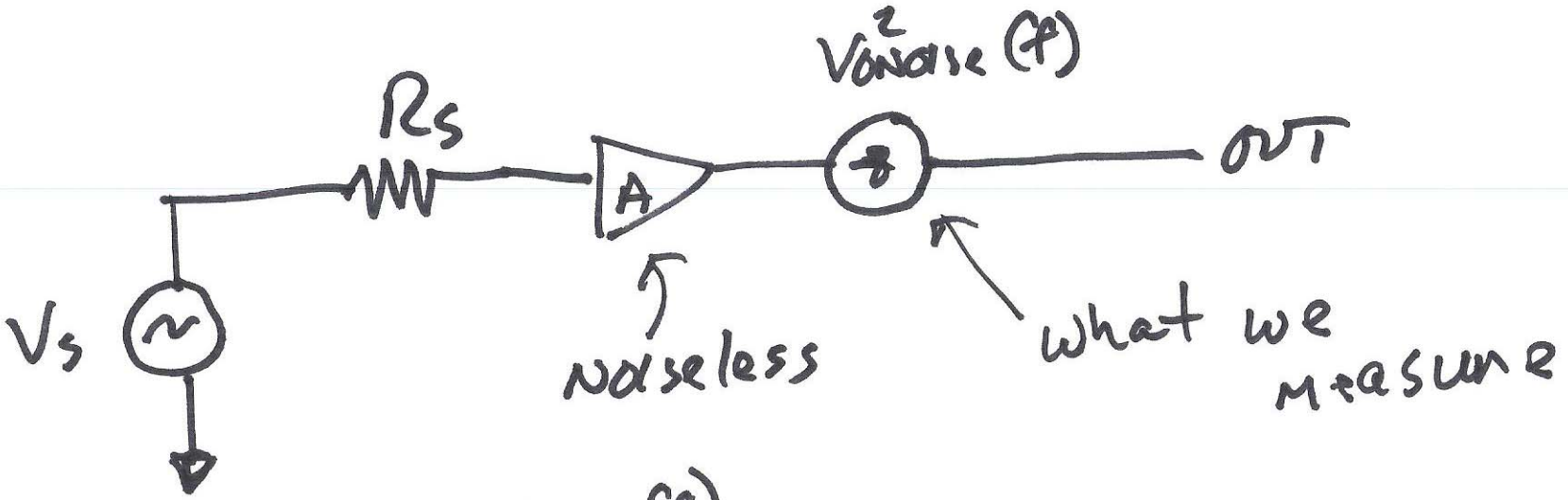
$\overline{V^2}$ ← MEAN SQUARED VOLTAGE

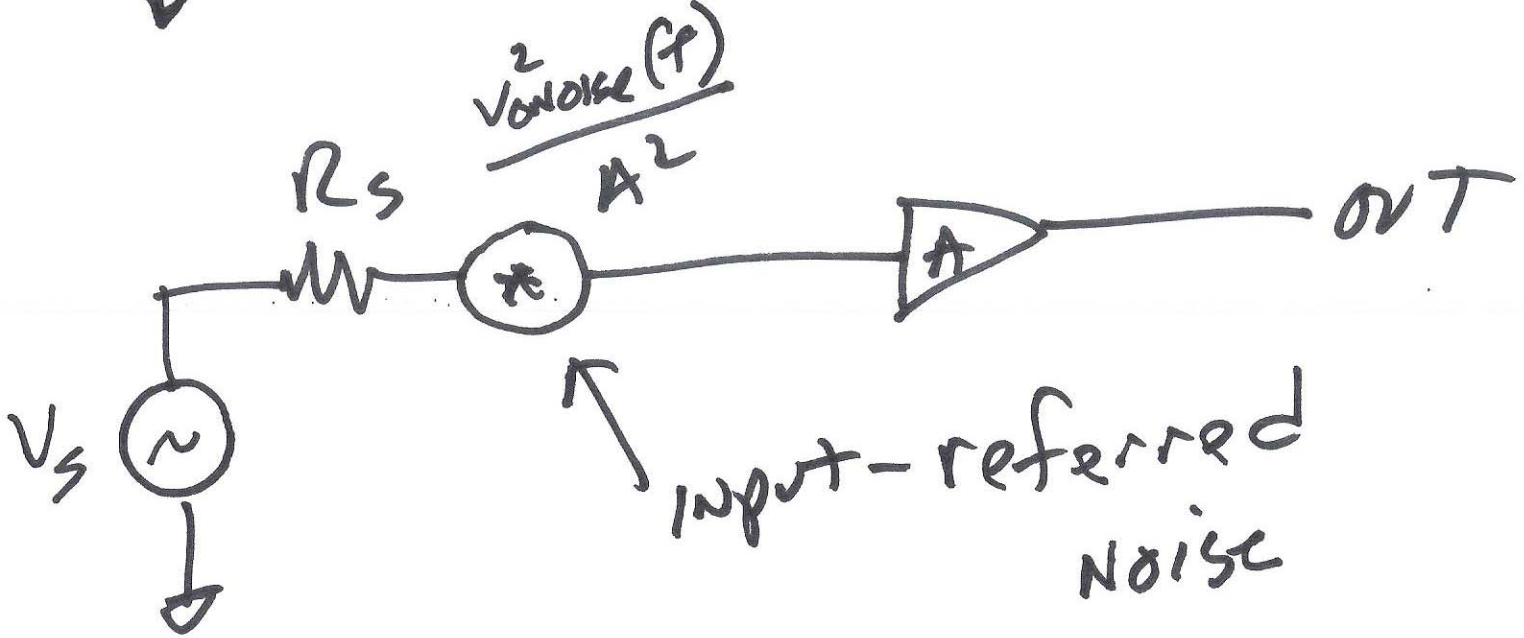
RMS = Sq. rt. of $\overline{V^2}$

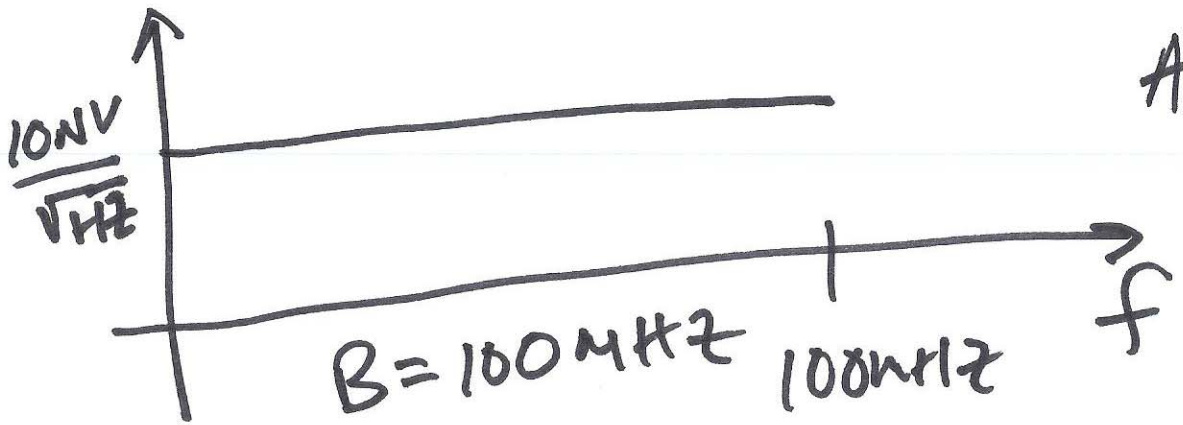
for white noise

$$V_{RMS} = \sqrt{V^2_{ONOISE}(f) \cdot \sqrt{(f_H - f_L)}}$$

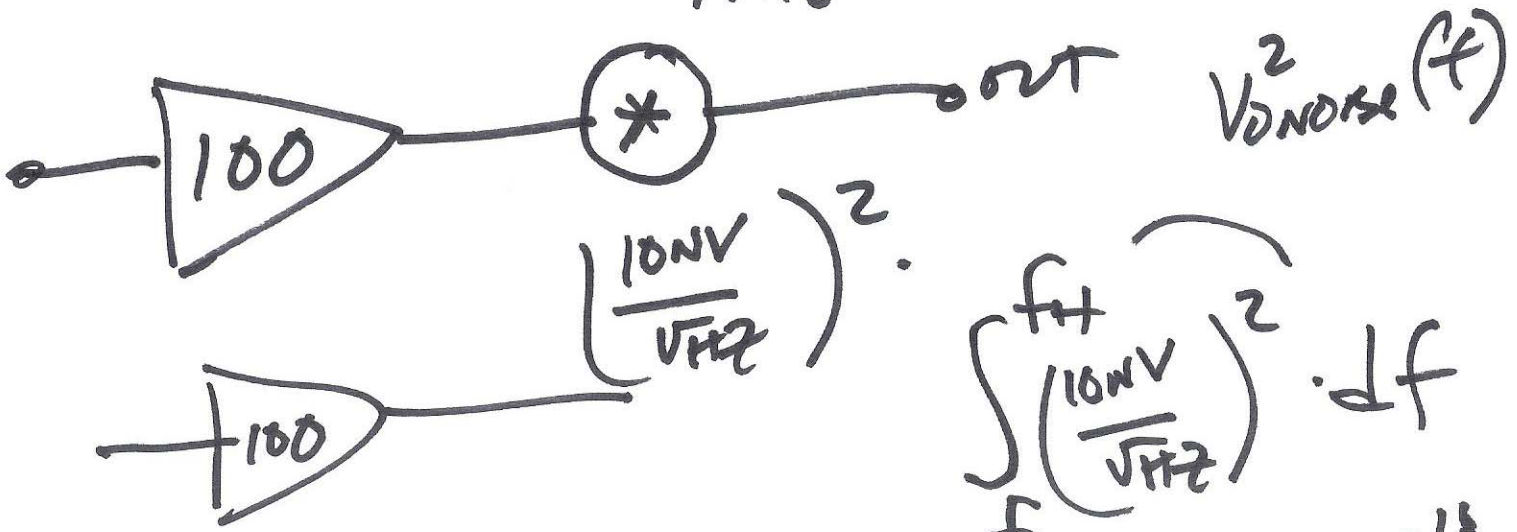
$$= \sqrt{B} \cdot V_{ONOISE}(f)$$


$V^2_{noise}(f)$
R_S
A
OUT
V_S
noiseless
what we measure


$\frac{V^2_{noise}(f)}{A^2}$
R_S
A
OUT
V_S
input-referred noise



estimate the RMS input referred noise.



$$\int_{f_L}^{f_H} \left(\frac{10NV}{\sqrt{HZ}}\right)^2 \cdot df$$

$$100 \cdot 10^{-18} \frac{V^2}{HZ} = 10 \cdot 10 \cdot 10^{-18}$$

RMS OUTPUT Voltage

$$V_{o,rms} = \sqrt{(f_H - f_L) \cdot 100 \cdot 10^{-18} \frac{V^2}{Hz}}$$

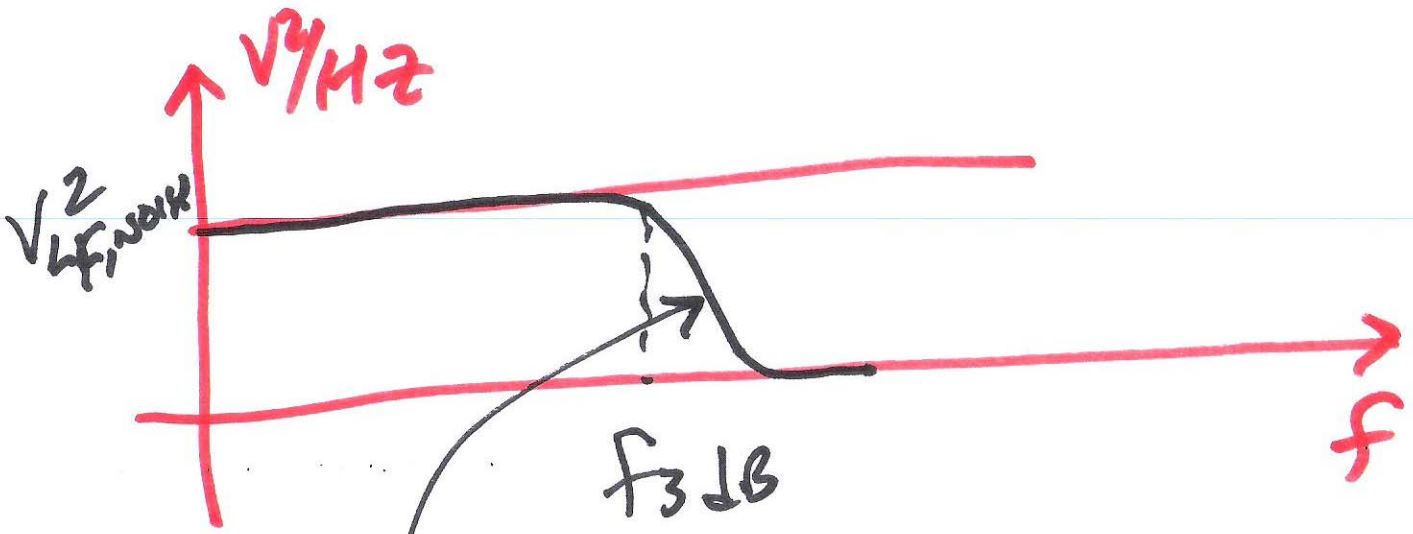
$$= \sqrt{100 \cdot 10^6 \cdot 100 \cdot 10^{-18}}$$

$$(10^{10} \cdot 10^{-18})^{1/2} = (10^{-8})^{1/2}$$

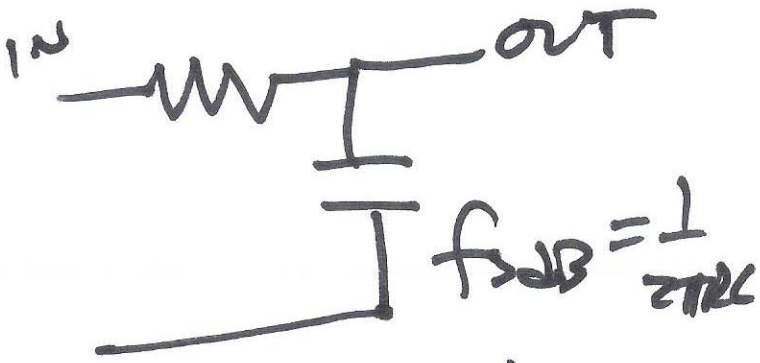
$$= 10^{-4}$$

$$= 100\ \mu V$$

$$V_{in,rms} = \frac{V_{o,rms}}{100} = 1\ \mu V$$



$$\frac{V_{LF,noise}^2}{\left(1+\left(f/f_{3dB}\right)^2\right)}$$



$$V_{ONOISE,rms}^2 = \int_0^\infty \frac{V_{LF,noise}^2}{1+\left(f/f_{3dB}\right)^2}\,df$$

$$\frac{V_{OUT}}{V_{in}} = \frac{1}{\sqrt{1+\left(f/f_{3dB}\right)^2}}$$

$$\int \frac{du}{a^2+u^2} = \frac{1}{a}\tan^{-1}\frac{u}{a} + C$$

6)

$$V_{oNOise,Rms}^2 = V_{LF,Noise}^2 \cdot f_{3dB} \cdot \tan^{-1} f/f_{3dB} \Big|_0^\infty$$

$$= V_{LF,Noise}^2 \cdot f_{3dB} \cdot \frac{\pi}{2}$$

$$\boxed{V_{ONOise,Rms} = \sqrt{V_{LFNoise}^2} \cdot \sqrt{\overset{NEB}{NEB}}}$$

$$V_{i,Noise,rms} = \frac{V_{o,Noise,rms}}{A}$$

$$V_{o,Noise}^2(f) = \frac{V_{LF,Noise}^2}{1 + (f/f_{3dB})^2}$$

$$A(f) = \frac{A}{\sqrt{1 + (f/f_{3dB})^2}}$$

$$V_{IN,Noise}^2(f) = \frac{V_{o,Noise}^2(f)}{A^2(f)}$$

$$V_{IN,Noise}^2(f) = \frac{V_{LF,Noise}^2}{A^2}$$

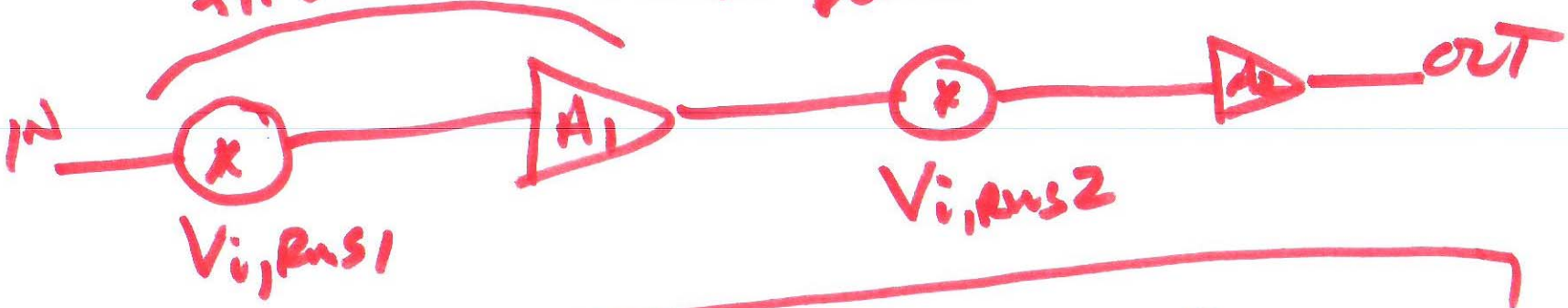
$$\int_0^\infty V_{IN,Noise}^2(f)\,df = \int_0^\infty \frac{V_{LF,Noise}^2}{A^2}\,df$$

A^2: CONST

$$= \infty$$

Can't calculate RMS input-referred noise using the input-referred noise spectrum!

first-stage noise performance

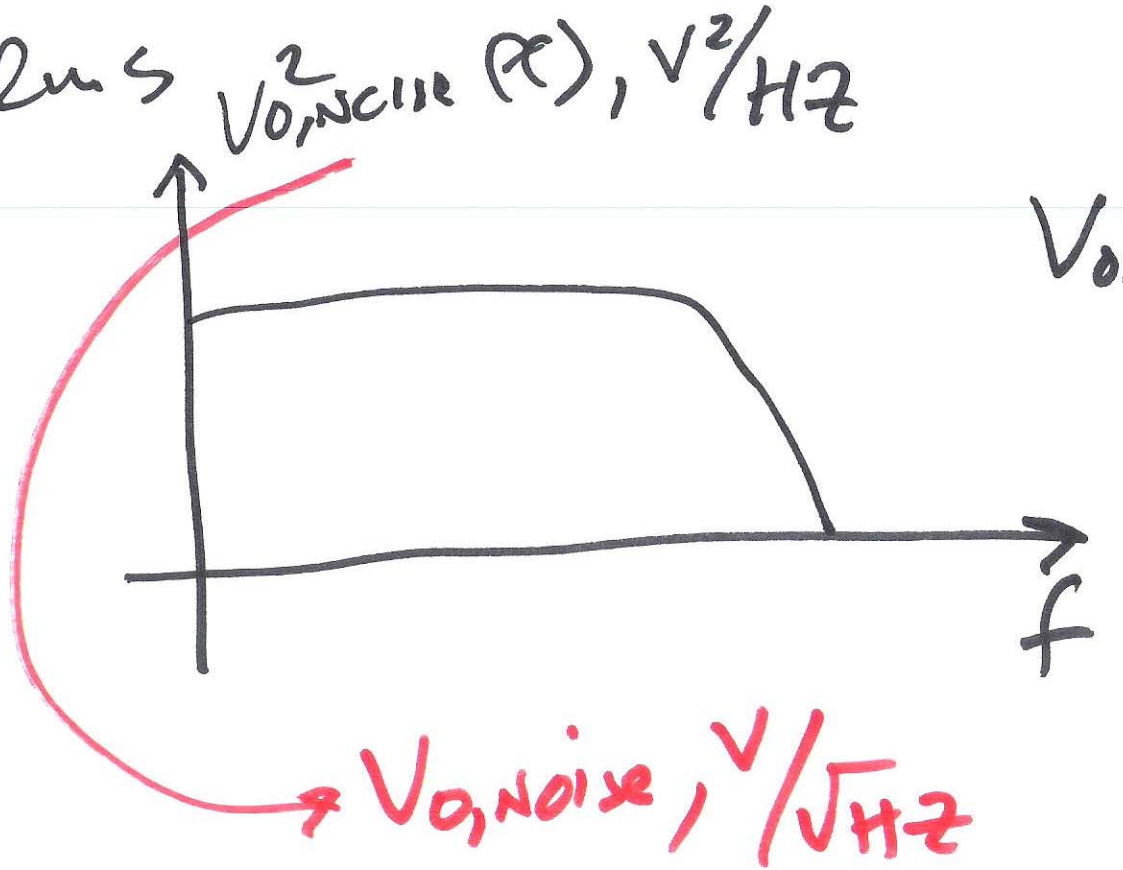


$$V_{OUT,Rms} = \sqrt{A_1^2 \cdot A_2^2 \cdot V_{i,Rms1}^2 + A_2^2 V_{i,Rms2}^2}$$

$$V_{IN,Rms} = \frac{\sqrt{A_1^2 A_2^2 \cdot V_{i,Rms1}^2 + A_2^2 V_{i,Rms2}^2}}{\sqrt{A_1^2 \; A_2^2}}$$

$$= \sqrt{V_{i,Rms1}^2 + \frac{V_{i,Rms2}^2}{A_1}}$$

Rms



$$V_{ORMS}^2 = \int_0^{\infty} V_{O,NOISE}^2(f) \cdot df$$

$$\frac{(V_{O,NOISE}, V)^2}{fres} \Rightarrow \frac{V^2}{Hz}$$