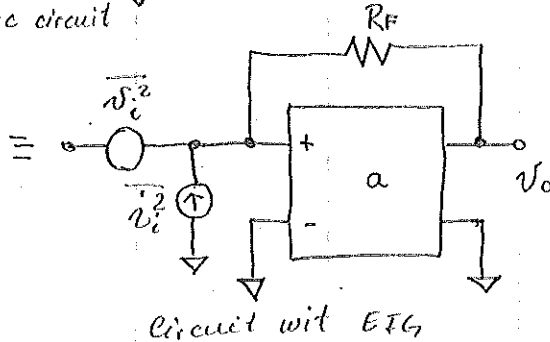
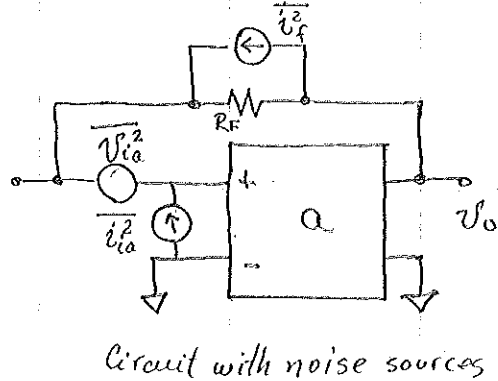
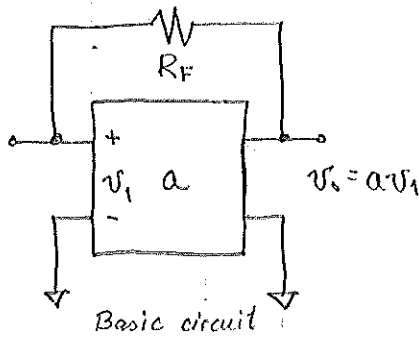


As a second practical case, consider a shunt-shunt feedback



Finding i_i : Open-ckt input and solve for v_o & equate

$$v_{o1} = i_i R_F \quad v_{o2} = v_{ia} \quad v_{o3} = i_i R_F \quad \text{in ckt's: } v_o = i_i R_F$$

Thus $i_i R_F = i_{ia} R_F + v_{ia} + i_i R_F \therefore i_i = i_{ia} + \frac{v_{ia}}{R_F} + i_i$

Assuming independence:

$$\overline{i_i^2} = \overline{i_{ia}^2} + \frac{\overline{v_{ia}^2}}{R_F^2} + 4KT \frac{1}{R_F}$$

\uparrow Thermal noise in R_F
 \uparrow Attenuated amplifier noise (negligible)
 \uparrow Amplifier current noise

Finding v_i : Short-ckt input and solve for v_o & equate:

Note that all current sources are shorted and $\overline{v_i^2} = \overline{v_{ia}^2}$

- In this case, the feedback has no effect on the voltage input noise.
- This second case readily applies to op-amps, because connecting one input to GND makes op-amp a two-port device
- When analyzing a BJT, these results justify ignoring $C_\mu \Rightarrow$ Behaves as shunt feedback and has no thermal noise component. The second term would become $\overline{v_{ia}^2} / |Z_F|^2$ with Z_F the impedance of C_μ , very large at practical frequencies, justifying the term as negligible

12-782 500 SHEETS, FILLER, 5 SQUARE
 42-381 50 SHEETS, VE-EASE, 5 SQUARE
 42-382 100 SHEETS, VE-EASE, 5 SQUARE
 42-383 100 SHEETS, VE-EASE, 5 SQUARE
 42-384 100 SHEETS, VE-EASE, 5 SQUARE
 42-385 100 RECYCLED WHITE, 5 SQUARE
 42-386 200 RECYCLED WHITE, 5 SQUARE
 Made in U.S.A.

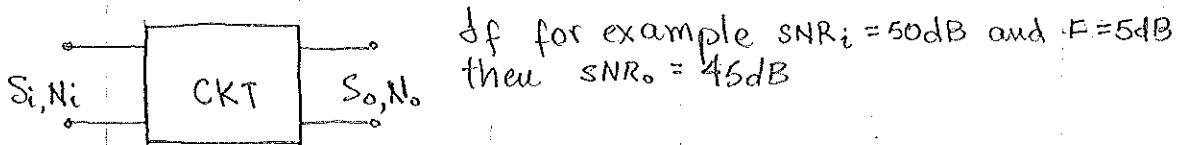


Noise Figure: Specifies noise performance in ckt. or device.

- Usage limited to circuits with resistive source impedance

Noise figure: $F = \frac{\text{Input SNR}}{\text{Output SNR}}$ in dB $(10 \log_{10})$

- F measures the SNR degradation caused by the circuit



Assume S & N represent the signal & noise power in a ckt.

$$F = \frac{S_i}{N_i} \cdot \frac{N_o}{S_o} \quad **$$

Assuming an ideal noiseless amplifier, all noise will come from the source resistance @ input. If the amplifier has gain G

$$S_o = G S_i \quad \text{and} \quad N_o = G N_i \Rightarrow F = 1 = 0 \text{dB}$$

However, decomposing F as in **, $F = \frac{N_o}{G N_i}$ resulting

$$F = \frac{\text{Total output noise}}{\text{Output noise due to source resistance}}$$

F is specified for a small bandwidth around some $f \gg \Delta f$: Spot noise figure

Noise Temperature: (T_n)

The temperature at which the source resistance R_s must be held such that the noise output in the circuit due to R_s equals the noise output due to the complete circuit.

- Useful for noise measures in very-low-noise amplifiers where $F \approx 1$

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