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Analog Noise and Power Analysis Formulas

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List of 14 Analog Noise and Power Analysis Formulas

Analog Noise and Power Analysis

1) Equivalent Noise Temperature

Open Calculator

fx $$T = (N_f - 1) \cdot T_o$$

ex $$363.743K = (2.22 - 1) \cdot 298.15K$$

2) Mean Square Value of Shot Noise

Open Calculator

fx $$i_{shot} = \sqrt{2 \cdot (i_t + i_o) \cdot [Charge\text{-}e] \cdot BW_{en}}$$

ex $$6.4E\hat{}\text{-}6mA = \sqrt{2 \cdot (8.25mA + 126mA) \cdot [Charge\text{-}e] \cdot 960Hz}$$

3) Noise Factor

Open Calculator

fx $$N_f = \frac{P_{si} \cdot P_{no}}{P_{so} \cdot P_{ni}}$$

ex $$2.222222 = \frac{25W \cdot 24W}{15W \cdot 18W}$$

4) Noise Power at Output of Amplifier

Open Calculator

fx $$P_{no} = P_{ni} \cdot N_f \cdot P_{ng}$$

ex $$23.976W = 18W \cdot 2.22 \cdot 0.6$$

5) Noise Power Gain

Open Calculator

fx $$P_{ng} = \frac{P_{so}}{P_{si}}$$

ex $$0.6 = \frac{15W}{25W}$$

6) Output SNR

Open Calculator

fx $$SNR = \log 10\left(\frac{P_s}{P_n}\right)$$

ex $$0.60206dB = \log 10\left(\frac{8W}{2W}\right)$$

7) Power Density Spectrum of Thermal Noise

Open Calculator

fx $$P_{dt} = 2 \cdot [BoltZ] \cdot T \cdot R_{ns}$$

ex $$1.2E\hat{}\text{-}20W/m^3 = 2 \cdot [BoltZ] \cdot 363.74K \cdot 1.23\Omega$$

8) Power Spectral Density of White Noise

Open Calculator

fx $$P_{dw} = [BoltZ] \cdot \frac{T}{2}$$

ex $$2.5E\hat{}\text{-}21W/m^3 = [BoltZ] \cdot \frac{363.74K}{2}$$

9) RMS Noise Voltage

Open Calculator

fx $$V_{rms} = \sqrt{4 \cdot [BoltZ] \cdot T \cdot BW_n \cdot R_{ns}}$$

ex $$2.2E\hat{}\text{-}6mV = \sqrt{4 \cdot [BoltZ] \cdot 363.74K \cdot 200Hz \cdot 1.23\Omega}$$

10) RMS Thermal Noise Current

Open Calculator

fx $$i_{rms} = \sqrt{4 \cdot [BoltZ] \cdot T \cdot G \cdot BW_n}$$

ex $$1.6E\hat{}\text{-}5mA = \sqrt{4 \cdot [BoltZ] \cdot 363.74K \cdot 60\mho \cdot 200Hz}$$

11) SNR for AM Demodulation

Open Calculator

fx $$SNR_{am} = \left(\frac{\mu^2 \cdot A_{sm}}{1 + \mu^2 \cdot A_{sm}}\right) \cdot SNR$$

ex $$0.02967dB = \left(\frac{(0.36)^2 \cdot 0.4}{1 + (0.36)^2 \cdot 0.4}\right) \cdot 0.602dB$$

12) SNR for FM System

Open Calculator

$$\mathrm{SNR_{fm}} = 3 \cdot \mathrm{D}^2 \cdot \mathrm{A_{sm}} \cdot \mathrm{SNR}$$

$$0.001806\mathrm{dB} = 3 \cdot (0.050)^2 \cdot 0.4 \cdot 0.602\mathrm{dB}$$

13) SNR for PM System

Open Calculator

$$\mathrm{SNR_{pm}} = \mathrm{k_p^2} \cdot \mathrm{A_{sm}} \cdot \mathrm{SNR}$$

$$3.8528\mathrm{dB} = (4)^2 \cdot 0.4 \cdot 0.602\mathrm{dB}$$

14) Thermal Noise Power

Open Calculator

$$\mathrm{P_{tn}} = [\mathrm{BoltZ}] \cdot \mathrm{T} \cdot \mathrm{BW_n}$$

$$1\mathrm{E\^{}\text{-}18W} = [\mathrm{BoltZ}] \cdot 363.74\mathrm{K} \cdot 200\mathrm{Hz}$$

Variables Used

- A_{sm} Amplitude of Message Signal
- BW_{en} Effective Noise Bandwidth *(Hertz)*
- BW_{n} Noise Bandwidth *(Hertz)*
- **D** Deviation Ratio
- **G** Conductance *(Mho)*
- i_{o} Reverse Saturation Current *(Milliampere)*
- i_{rms} RMS Thermal Noise Current *(Milliampere)*
- i_{shot} Mean Square Shot Noise Current *(Milliampere)*
- i_{t} Total Current *(Milliampere)*
- k_{p} Phase Deviation Constant
- N_{f} Noise Factor
- P_{dt} Power Spectral Density of Thermal Noise *(Watt Per Cubic Meter)*
- P_{dw} Power Spectral Density of White Noise *(Watt Per Cubic Meter)*
- P_{n} Noise Power *(Watt)*
- P_{ng} Noise Power Gain
- P_{ni} Noise Power at Input *(Watt)*
- P_{no} Noise Power at Output *(Watt)*
- P_{s} Signal Power *(Watt)*
- P_{si} Signal Power at Input *(Watt)*
- P_{so} Signal Power at Output *(Watt)*
- P_{tn} Thermal Noise Power *(Watt)*

- R_{ns} Noise Resistance *(Ohm)*
- **SNR** Signal to Noise Ratio *(Decibel)*
- SNR_{am} SNR of AM System *(Decibel)*
- SNR_{fm} SNR of FM System *(Decibel)*
- SNR_{pm} SNR of PM System *(Decibel)*
- **T** Temperature *(Kelvin)*
- T_o Room Temperature *(Kelvin)*
- V_{rms} RMS Noise Voltage *(Millivolt)*
- **μ** Modulation Index

Constants, Functions, Measurements used

- Constant: **[BoltZ]**, 1.38064852E-23 Joule/Kelvin
  Boltzmann constant
- Constant: **[Charge-e]**, 1.60217662E-19 Coulomb
  Charge of electron
- Function: **log10**, log10(Number)
  Common logarithm function (base 10)
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Electric Current** in Milliampere (mA)
  Electric Current Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion
- Measurement: **Electric Conductance** in Mho (℧)
  Electric Conductance Unit Conversion
- Measurement: **Electric Potential** in Millivolt (mV)
  Electric Potential Unit Conversion
- Measurement: **Sound** in Decibel (dB)
  Sound Unit Conversion
- Measurement: **Power Density** in Watt Per Cubic Meter (W/m³)
  Power Density Unit Conversion

Check other formula lists

- **Amplitude Modulation Characteristics Formulas**
- **Analog Noise and Power Analysis Formulas**
- **Fundamentals of Analog Communications Formulas**
- **Sideband and Frequency Modulation Formulas**

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