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Fundamentals of Analog Communications Formulas

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List of 24 Fundamentals of Analog Communications Formulas

Fundamentals of Analog Communications

1) Amplitude of Carrier Signal

Open Calculator

fx $$A_c = \frac{A_{max} + A_{min}}{2}$$

ex $$17\text{V} = \frac{19.2032\text{V} + 14.7968\text{V}}{2}$$

2) Bandwidth of Tuned Circuit

Open Calculator

fx $$BW_{tuned} = \frac{\omega_r}{Q_{tc}}$$

ex $$3.491124\text{Hz} = \frac{11.8\text{Hz}}{3.38}$$

3) Carrier Frequency

Open Calculator

fx $$f_c = \frac{\omega_m}{2 \cdot \pi}$$

ex $$50.13381\text{Hz} = \frac{315\text{rad/s}}{2 \cdot \pi}$$

4) Carrier Power

Open Calculator

fx $$P_c = \frac{A_c^2}{2 \cdot R}$$

ex $$1.153693\text{W} = \frac{(17\text{V})^2}{2 \cdot 125.25\Omega}$$

5) Crest Factor

Open Calculator

fx $$CF = \frac{X_{peak}}{X_{rms}}$$

ex $$3.913043 = \frac{90\text{V}}{23\text{V}}$$

6) Cyclic Frequency of Superheterodyne Receiver

Open Calculator

fx $$f_{cyc} = \frac{1}{2 \cdot \pi \cdot \sqrt{L \cdot C}}$$

ex $$0.038488\text{Hz} = \frac{1}{2 \cdot \pi \cdot \sqrt{5.7\text{H} \cdot 3\text{F}}}$$

7) Deviation Ratio

Open Calculator

fx $$D = \frac{\Delta f_m}{f_m}$$

ex $$0.05 = \frac{750\text{Hz}}{15000\text{Hz}}$$

8) Figure of Merit of Superheterodyne Receiver

Open Calculator

fx $$\mathrm{FOM} = \frac{1}{\mathrm{F}}$$

ex $$0.04 = \frac{1}{25}$$

9) Image Frequency

Open Calculator

fx $$\mathrm{f_{img}} = \mathrm{F_{RF}} + (2 \cdot \mathrm{f_{im}})$$

ex $$195\mathrm{Hz} = 55\mathrm{Hz} + (2 \cdot 70\mathrm{Hz})$$

10) Image Frequency Rejection Ratio of Superheterodyne Receiver

Open Calculator

fx $$\mathrm{IMRR} = \sqrt{1 + (\mathrm{Q})^2 \cdot (\mathrm{cf})^2}$$

ex $$1.21189 = \sqrt{1 + (0.21)^2 \cdot (3.26)^2}$$

11) Image Rejection Ratio

Open Calculator

fx $$\rho = \left(\frac{\mathrm{f_{img}}}{\mathrm{F_{RF}}}\right) - \left(\frac{\mathrm{F_{RF}}}{\mathrm{f_{img}}}\right)$$

ex $$3.263403\mathrm{dB} = \left(\frac{195\mathrm{Hz}}{55\mathrm{Hz}}\right) - \left(\frac{55\mathrm{Hz}}{195\mathrm{Hz}}\right)$$

12) Intermediate Frequency

Open Calculator

fx $$f_{im} = (f_{lo} - F_{RF})$$

ex $$70\text{Hz} = (125\text{Hz} - 55\text{Hz})$$

13) Maximum Amplitude

Open Calculator

fx $$A_{max} = A_c \cdot \left(1 + \mu^2\right)$$

ex $$19.2032\text{V} = 17\text{V} \cdot \left(1 + (0.36)^2\right)$$

14) Minimum Amplitude

Open Calculator

fx $$A_{min} = A_c \cdot \left(1 - \mu^2\right)$$

ex $$14.7968\text{V} = 17\text{V} \cdot \left(1 - (0.36)^2\right)$$

15) Modulation Index

Open Calculator

fx $$\mu = \frac{A_m}{A_c}$$

ex $$0.36 = \frac{6.12\text{V}}{17\text{V}}$$

16) Modulation Index with respect to Amplitude Sensitivity

Open Calculator

fx $\mu = K_a \cdot A_m$

ex $0.306 = 0.05 \cdot 6.12\text{V}$

17) Modulation Index with respect to Maximum and Minimum Amplitude

Open Calculator

fx $\mu = \frac{A_{max} - A_{min}}{A_{max} + A_{min}}$

ex $0.1296 = \frac{19.2032\text{V} - 14.7968\text{V}}{19.2032\text{V} + 14.7968\text{V}}$

18) Modulation Index with respect to Power

Open Calculator

fx $\mu = \sqrt{2 \cdot \left(\left(\frac{P_T}{P_{c(avg)}}\right) - 1\right)}$

ex $0.367527 = \sqrt{2 \cdot \left(\left(\frac{4.9\text{W}}{4.59\text{W}}\right) - 1\right)}$

19) Noise Figure of Superheterodyne Receiver

Open Calculator

fx $F = \frac{1}{FOM}$

ex $25 = \frac{1}{0.04}$

20) Phase Constant of Distortion Less Line

Open Calculator

fx $\beta = \omega \cdot \sqrt{L \cdot C}$

ex $8.270429 = 2\text{rad/s} \cdot \sqrt{5.7\text{H} \cdot 3\text{F}}$

21) Phase Velocity of Distortion Less Line

Open Calculator

fx $V_p = \frac{1}{\sqrt{L \cdot C}}$

ex $0.241825\text{m/s} = \frac{1}{\sqrt{5.7\text{H} \cdot 3\text{F}}}$

22) Quality Factor of Tuned Circuit

Open Calculator

fx $Q_{tc} = \frac{2 \cdot \pi \cdot \omega_r \cdot L}{R}$

ex $3.374108 = \frac{2 \cdot \pi \cdot 11.8\text{Hz} \cdot 5.7\text{H}}{125.25\Omega}$

23) Rejection Ratio

Open Calculator

fx $\alpha = \sqrt{1 + \left(Q_{tc}^2 \cdot \rho^2\right)}$

ex $11.07553\text{dB} = \sqrt{1 + \left((3.38)^2 \cdot (3.2634\text{dB})^2\right)}$

24) Transmission Efficiency with respect to Modulation Index

Open Calculator

fx $$\eta_{am} = \frac{\mu^2}{2 + \mu^2}$$

ex $$0.060856 = \frac{(0.36)^2}{2 + (0.36)^2}$$

Variables Used

- A_c Amplitude of Carrier Signal *(Volt)*
- A_m Amplitude of Modulating Signal *(Volt)*
- A_{max} Maximum Amplitude of AM Wave *(Volt)*
- A_{min} Minimum Amplitude of AM Wave *(Volt)*
- BW_{tuned} Tuned Circuit Bandwidth *(Hertz)*
- **C** Capacitance *(Farad)*
- **cf** Coupling Factor
- **CF** Crest Factor
- **D** Deviation Ratio
- **F** Noise Figure
- f_c Carrier Frequency *(Hertz)*
- f_{cyc} Cyclic Frequency *(Hertz)*
- f_{im} Intermediate Frequency *(Hertz)*
- f_{img} Image Frequency *(Hertz)*
- f_{lo} Local Oscillation Frequency *(Hertz)*
- f_m Maximum Modulating Frequency *(Hertz)*
- F_{RF} Received Signal Frequency *(Hertz)*
- **FOM** Figure of Merit
- **IMRR** Image Frequency Rejection Ratio
- K_a Amplitude Sensitivity of Modulator
- **L** Inductance *(Henry)*
- P_c Carrier Power *(Watt)*

- $P_{c(avg)}$ Average Carrier Power of AM Wave *(Watt)*
- P_T Average Total Power of AM Wave *(Watt)*
- Q Quality Factor
- Q_{tc} Quality Factor of Tuned Circuit
- R Resistance *(Ohm)*
- V_p Phase Velocity of Distortion Less Line *(Meter per Second)*
- X_{peak} Peak Value of Signal *(Volt)*
- X_{rms} RMS Value of Signal *(Volt)*
- α Rejection Ratio *(Decibel)*
- β Phase Constant of Distortion Less Line
- Δf_m Maximum Frequency Deviation *(Hertz)*
- η_{am} Transmission Efficiency of AM Wave
- μ Modulation Index
- ρ Image Rejection Ratio *(Decibel)*
- ω Angular Velocity *(Radian per Second)*
- ω_m Angular Frequency of Modulating Signal *(Radian per Second)*
- ω_r Resonant Frequency *(Hertz)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Noise** in Decibel (dB)
  Noise Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Capacitance** in Farad (F)
  Capacitance Unit Conversion
- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion
- Measurement: **Inductance** in Henry (H)
  Inductance Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion
- Measurement: **Angular Velocity** in Radian per Second (rad/s)
  Angular Velocity Unit Conversion
- Measurement: **Angular Frequency** in Radian per Second (rad/s)
  Angular Frequency Unit Conversion

Check other formula lists

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

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