Important Fundamentals of Analog Communications Formulas PDF

Formulas
Examples
with Units

List of 24
Important Fundamentals of Analog Communications Formulas

1) Amplitude of Carrier Signal Formula

Evaluate Formula

Formula

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

Example with Units

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

2) Bandwidth of Tuned Circuit Formula

Evaluate Formula

Formula

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

Example with Units

$$3.4911\,\text{Hz} = \frac{11.8\,\text{Hz}}{3.38}$$

3) Carrier Frequency Formula

Evaluate Formula

Formula

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

Example with Units

$$50.1338\,\text{Hz} = \frac{315\,\text{rad/s}}{2 \cdot 3.1416}$$

4) Carrier Power Formula

Evaluate Formula

Formula

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

Example with Units

$$1.1537\,\text{W} = \frac{17\,\text{V}^2}{2 \cdot 125.25\,\Omega}$$

5) Crest Factor Formula

Evaluate Formula

Formula

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

Example with Units

$$3.913 = \frac{90\,\text{V}}{23\,\text{V}}$$

6) Cyclic Frequency of Superheterodyne Receiver Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0385\,\text{Hz} = \frac{1}{2 \cdot 3.1416 \cdot \sqrt{5.7\,\text{H} \cdot 3\,\text{F}}}$$

7) Deviation Ratio Formula

Evaluate Formula

Formula

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

Example with Units

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

8) Figure of Merit of Superheterodyne Receiver Formula

Evaluate Formula

Formula

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

Example

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

9) Image Frequency Formula

Evaluate Formula

Formula

$$f_{img} = F_{RF} + \left(2 \cdot f_{im}\right)$$

Example with Units

$$195\,\text{Hz} = 55\,\text{Hz} + \left(2 \cdot 70\,\text{Hz}\right)$$

10) Image Frequency Rejection Ratio of Superheterodyne Receiver Formula

Evaluate Formula

Formula

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

Example

$$1.2119 = \sqrt{1 + \left(0.21\right)^2 \cdot \left(3.26\right)^2}$$

11) Image Rejection Ratio Formula

Evaluate Formula

Formula

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

Example with Units

$$3.2634\,\text{dB} = \left(\frac{195\,\text{Hz}}{55\,\text{Hz}}\right) - \left(\frac{55\,\text{Hz}}{195\,\text{Hz}}\right)$$

12) Intermediate Frequency Formula

Evaluate Formula

Formula

$$f_{im} = \left(f_{lo} - F_{RF}\right)$$

Example with Units

$$70\,\text{Hz} = \left(125\,\text{Hz} - 55\,\text{Hz}\right)$$

13) Maximum Amplitude Formula

Evaluate Formula

Formula

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

Example with Units

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

14) Minimum Amplitude Formula

Evaluate Formula

Formula

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

Example with Units

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

15) Modulation Index Formula

Evaluate Formula

Formula

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

Example with Units

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

16) Modulation Index with respect to Amplitude Sensitivity Formula

Evaluate Formula

Formula

$$\mu = K_a \cdot A_m$$

Example with Units

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

17) Modulation Index with respect to Maximum and Minimum Amplitude Formula

Evaluate Formula

Formula

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

Example with Units

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

18) Modulation Index with respect to Power Formula

Evaluate Formula

Formula

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

Example with Units

$$0.3675 = \sqrt{2 \cdot \left(\left(\frac{4.9\,\text{W}}{4.59\,\text{W}}\right) - 1\right)}$$

19) Noise Figure of Superheterodyne Receiver Formula

Evaluate Formula

Formula

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

Example

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

20) Phase Constant of Distortion Less Line Formula

Evaluate Formula

Formula

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

Example with Units

$$8.2704 = 2\,\text{rad/s} \cdot \sqrt{5.7\,\text{H} \cdot 3\,\text{F}}$$

21) Phase Velocity of Distortion Less Line Formula

Evaluate Formula

Formula

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

Example with Units

$$0.2418\,\text{m/s} = \frac{1}{\sqrt{5.7\,\text{H} \cdot 3\,\text{F}}}$$

22) Quality Factor of Tuned Circuit Formula

Evaluate Formula

Formula

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

Example with Units

$$3.3741 = \frac{2 \cdot 3.1416 \cdot 11.8\,\text{Hz} \cdot 5.7\,\text{H}}{125.25\,\Omega}$$

23) Rejection Ratio Formula

Evaluate Formula

Formula

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

Example with Units

$$11.0755\,\text{dB} = \sqrt{1 + \left({3.38}^2 \cdot {3.2634\,\text{dB}}^2 \right)}$$

24) Transmission Efficiency with respect to Modulation Index Formula

Evaluate Formula

Formula

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

Example

$$0.0609 = \frac{0.36^2}{2 + 0.36^2}$$

Variables used in list of Fundamentals of Analog Communications Formulas above

- 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)*

Constants, Functions, Measurements used in list of Fundamentals of Analog Communications Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- 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*

- 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)*

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