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# Amplitude Modulation Characteristics Formulas

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# List of 18 Amplitude Modulation Characteristics Formulas

## Amplitude Modulation Characteristics

### 1) Amplitude of Each Sideband

$$\text{fx } A_{\text{sb}} = \frac{\mu \cdot A_c}{2}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b\_img.jpg\)](#)

$$\text{ex } 3.06\text{V} = \frac{0.36 \cdot 17\text{V}}{2}$$

### 2) Amplitude Sensitivity of Modulator

$$\text{fx } K_a = \frac{1}{A_c}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d\_img.jpg\)](#)

$$\text{ex } 0.058824 = \frac{1}{17\text{V}}$$

### 3) Average Total Power of AM Wave

$$\text{fx } P_t = P_c \cdot \left( 1 + \frac{\mu^2}{2} \right)$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d\_img.jpg\)](#)

$$\text{ex } 1.230909\text{W} = 1.156\text{W} \cdot \left( 1 + \frac{(0.36)^2}{2} \right)$$



#### 4) Bandwidth Improvement of AM Receiver

$$\text{fx } B_{\text{imp}} = \frac{BW_{\text{rf}}}{B_{\text{if}}}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$\text{ex } 100 = \frac{90000\text{b/s}}{900\text{b/s}}$$

#### 5) Bandwidth of AM wave

$$\text{fx } BW_{\text{am}} = 2 \cdot f_{\text{m}}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$\text{ex } 300\text{Hz} = 2 \cdot 150\text{Hz}$$

#### 6) Coupling Factor of AM Receiver

$$\text{fx } cf = \left( \frac{f_{\text{img}}}{f_{\text{rf}}} \right) - \left( \frac{f_{\text{rf}}}{f_{\text{img}}} \right)$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

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

#### 7) Image Frequency Bandwidth of AM Receiver

$$\text{fx } B_{\text{if}} = \frac{BW_{\text{rf}}}{B_{\text{imp}}}$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

$$\text{ex } 900\text{b/s} = \frac{90000\text{b/s}}{100}$$



## 8) Local Oscillation Frequency of AM Receiver

$$f_x \quad f_{lo} = f_{rf} + f_{im}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$ex \quad 125Hz = 55Hz + 70Hz$$

## 9) Magnitude of Modulating Signal

$$f_x \quad A = \frac{A_{max} - A_{min}}{2}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$ex \quad 2.2032V = \frac{19.2032V - 14.7968V}{2}$$

## 10) Maximum Amplitude of AM Wave

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

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$ex \quad 19.2032V = 17V \cdot (1 + (0.36)^2)$$

## 11) Minimum Amplitude of AM Wave

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

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b\_img.jpg\)](#)

$$ex \quad 14.7968V = 17V \cdot (1 - (0.36)^2)$$



## 12) Phase Deviation of AM Receiver

$$\text{fx } \Delta P = K_p \cdot A_m \cdot F_m$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$\text{ex } 911.9908 = 3.3 \cdot 6.12\text{V} \cdot 45.157\text{Hz}$$

## 13) Post Detection Signal to Noise Ratio of AM

$$\text{fx } \text{SNR}_{\text{post}} = \frac{A_c^2 \cdot K_a^2 \cdot P_t}{2 \cdot N_0 \cdot \text{BW}_{\text{tm}}}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$\text{ex } 0.022578 = \frac{(17\text{V})^2 \cdot (0.05)^2 \cdot 1.4\text{W}}{2 \cdot 0.0056\text{W}^*_{\text{s}} \cdot 4000\text{Hz}}$$

## 14) Pre Detection Signal to Noise Ratio of AM

$$\text{fx } \text{SNR}_{\text{pre}} = \frac{A_c^2 \cdot (1 + K_a^2 \cdot P_t)}{2 \cdot N_0 \cdot \text{BW}_{\text{tm}}}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$\text{ex } 6.473471\text{dB} = \frac{(17\text{V})^2 \cdot (1 + (0.05)^2 \cdot 1.4\text{W})}{2 \cdot 0.0056\text{W}^*_{\text{s}} \cdot 4000\text{Hz}}$$

## 15) Quality Factor of AM Receiver

$$\text{fx } Q = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{L}{C}}$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80\_img.jpg\)](#)

$$\text{ex } 0.21938 = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{5.7\text{H}}{3\text{F}}}$$



## 16) Radio Frequency Bandwidth of AM Receiver

$$\text{fx } BW_{\text{rf}} = B_{\text{imp}} \cdot B_{\text{if}}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)

$$\text{ex } 90000\text{b/s} = 100 \cdot 900\text{b/s}$$

## 17) Total Current of AM Wave

$$\text{fx } i_t = I_c \cdot \sqrt{1 + \left(\frac{\mu^2}{2}\right)}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

$$\text{ex } 1.702621\text{A} = 1.65\text{A} \cdot \sqrt{1 + \left(\frac{(0.36)^2}{2}\right)}$$

## 18) Total Power of AM wave

$$\text{fx } P_t = P_c + P_{\text{usb}} + P_{\text{lsb}}$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60\_img.jpg\)](#)

$$\text{ex } 1.56754\text{W} = 1.156\text{W} + 0.037\text{W} + 0.37454\text{W}$$



## Variables Used

- **A** Modulating Signal Magnitude (Volt)
- **A<sub>C</sub>** Amplitude of Carrier Signal (Volt)
- **A<sub>m</sub>** Amplitude of Modulating Signal (Volt)
- **A<sub>max</sub>** Maximum Amplitude of AM Wave (Volt)
- **A<sub>min</sub>** Minimum Amplitude of AM Wave (Volt)
- **A<sub>sb</sub>** Amplitude of each Sideband (Volt)
- **B<sub>if</sub>** Image Frequency Bandwidth (Bit Per Second)
- **B<sub>imp</sub>** Bandwidth Improvement
- **BW<sub>am</sub>** Bandwidth of AM Wave (Hertz)
- **BW<sub>rf</sub>** Radio Frequency Bandwidth (Bit Per Second)
- **BW<sub>tm</sub>** Transmission Bandwidth (Hertz)
- **C** Capacitance (Farad)
- **cf** Coupling Factor
- **f<sub>im</sub>** Intermediate Frequency (Hertz)
- **f<sub>img</sub>** Image Frequency (Hertz)
- **f<sub>lo</sub>** Local Oscillation Frequency (Hertz)
- **f<sub>m</sub>** Maximum Frequency (Hertz)
- **F<sub>m</sub>** Modulating Signal Frequency (Hertz)
- **f<sub>rf</sub>** Radio Frequency (Hertz)
- **I<sub>C</sub>** Carrier Current (Ampere)
- **i<sub>t</sub>** Total Current of AM Wave (Ampere)












- $K_a$  Amplitude Sensitivity of Modulator
- $K_p$  Proportionality Constant
- $L$  Inductance (Henry)
- $N_0$  Noise Density (Watt-Second)
- $P_c$  Carrier Power (Watt)
- $P_{lsb}$  Lower Sideband Power (Watt)
- $P_t$  Total Power (Watt)
- $P_{usb}$  Upper Sideband Power (Watt)
- $Q$  Quality Factor
- $SNR_{post}$  Post Detection SNR of AM
- $SNR_{pre}$  Pre Detection SNR of SSB (Decibel)
- $\Delta P$  Phase Deviation
- $\mu$  Modulation Index









## Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288  
*Archimedes' constant*
- **Function:** **sqrt**, sqrt(Number)  
*Square root function*
- **Measurement:** **Electric Current** in Ampere (A)  
*Electric Current Unit Conversion* 
- **Measurement:** **Energy** in Watt-Second (W\*s)  
*Energy 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:** **Inductance** in Henry (H)  
*Inductance Unit Conversion* 
- **Measurement:** **Electric Potential** in Volt (V)  
*Electric Potential Unit Conversion* 
- **Measurement:** **Bandwidth** in Bit Per Second (b/s)  
*Bandwidth 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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