Important Sideband and Frequency Modulation Formulas PDF

Formulas
Examples
with Units

List of 21
Important Sideband and Frequency Modulation Formulas

1) Bandwidth in DSB-SC Formula

Evaluate Formula

Formula

$$BW_{DSB} = 2 \cdot f_{m\text{-}DSB}$$

Example with Units

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

2) Bandwidth of FM by Carson Rule with Beta Formula

Evaluate Formula

Formula

$$BW_{FM} = 2 \cdot (1 + \beta) \cdot f_{mod}$$

Example with Units

$$160\,\text{Hz} = 2 \cdot (1 + 0.6) \cdot 50\,\text{Hz}$$

3) Bandwidth of FM wave by Carson Rule Formula

Evaluate Formula

Formula

$$BW_{FM} = 2 \cdot (\Delta f + f_{mod})$$

Example with Units

$$160\,\text{Hz} = 2 \cdot (30\,\text{Hz} + 50\,\text{Hz})$$

4) Bandwidth of VSB Formula

Evaluate Formula

Formula

$$BW_{VSB} = f_{m\text{-}DSB} + f_{v\text{-}DSB}$$

Example with Units

$$250\,\text{Hz} = 150\,\text{Hz} + 100\,\text{Hz}$$

5) Bandwidth with respect to Modulation Index of FM Formula

Evaluate Formula

Formula

$$BW_{FM} = (2 \cdot \Delta f) \cdot \left(1 + \left(\frac{1}{\beta}\right)\right)$$

Example with Units

$$160\,\text{Hz} = (2 \cdot 30\,\text{Hz}) \cdot \left(1 + \left(\frac{1}{0.6}\right)\right)$$

6) Carrier Swing Formula

Evaluate Formula

Formula

$$f_{cs} = 2 \cdot \Delta f$$

Example with Units

$$60\,\text{Hz} = 2 \cdot 30\,\text{Hz}$$

7) Frequency Deviation Formula

Evaluate Formula

Formula

$$\Delta f = K_f \cdot A_{m(peak)}$$

Example with Units

$$30\,\text{Hz} = 0.75\,\text{Hz} \cdot 40\,\text{V}$$

8) Frequency Deviation provided Modulation Index Formula

Evaluate Formula

Formula

$$\Delta f = \beta \cdot f_{mod}$$

Example with Units

$$30\,\text{Hz} = 0.6 \cdot 50\,\text{Hz}$$

9) Frequency Sensitivity Formula

Evaluate Formula

Formula

$$K_f = \frac{\Delta f}{A_{m(peak)}}$$

Example with Units

$$0.75\,\text{Hz} = \frac{30\,\text{Hz}}{40\,\text{V}}$$

10) Lower Sideband Frequency Formula

Evaluate Formula

Formula

$$f_{LSB} = \left(f_c - f_{msg} \right)$$

Example with Units

$$35.133\,\text{Hz} = \left(50.133\,\text{Hz} - 15\,\text{Hz} \right)$$

11) Lower Sideband Power Formula

Evaluate Formula

Formula

$$P_{lsb} = {A_c}^2 \cdot \frac{\mu^2}{8 \cdot R}$$

Example with Units

$$0.0374\,\text{W} = 17\,\text{V}^2 \cdot \frac{0.36^2}{8 \cdot 125.25\,\Omega}$$

12) Lower Sideband Power with respect to Carrier Power Formula

Evaluate Formula

Formula

$$P_{lsb} = P_c \cdot \frac{\mu^2}{4}$$

Example with Units

$$0.0375\,\text{W} = 1.156\,\text{W} \cdot \frac{0.36^2}{4}$$

13) Modulating Frequency Formula

Evaluate Formula

Formula

$$f_{mod} = \frac{\omega}{2 \cdot \pi}$$

Example with Units

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

14) Modulating Signal Amplitude of FM Receiver Formula

Evaluate Formula

Formula

$$A_m = \frac{\Delta P}{K_p \cdot F_m}$$

Example with Units

$$6.1201\,\text{V} = \frac{912.0}{3.3 \cdot 45.157\,\text{Hz}}$$

15) Modulating Signal Frequency of FM Receiver Formula

Evaluate Formula

Formula

$$F_m = \frac{\Delta P}{K_p \cdot A_m}$$

Example with Units

$$45.1575\,\text{Hz} = \frac{912.0}{3.3 \cdot 6.12\,\text{V}}$$

16) Modulation Index of FM Wave Formula

Evaluate Formula

Formula

$$\beta = \frac{\Delta f}{f_{mod}}$$

Example with Units

$$0.6 = \frac{30\,\text{Hz}}{50\,\text{Hz}}$$

17) Pre Detection Signal to Noise Ratio Formula

Evaluate Formula

Formula

$$SNR_{pre} = \frac{A_{DSB}^{2} \cdot P_{DSB\text{-}SC}}{2 \cdot N_{0\text{-}DSB} \cdot BW_{t\text{-}DSB}}$$

Example with Units

$$0.4688\,\text{dB} = \frac{16.999\,\text{V}^{2} \cdot 129.8\,\text{W}}{2 \cdot 10\,\text{W*s} \cdot 4000\,\text{Hz}}$$

18) Transmitted Power of DSB-SC Formula

Evaluate Formula

Formula

$$P_{t\text{-}DSB} = P_{U\text{-}DSB} + P_{L\text{-}DSB}$$

Example with Units

$$351\,\text{W} = 250.5\,\text{W} + 100.5\,\text{W}$$

19) Upper Sideband Frequency Formula

Evaluate Formula

Formula

$$f_{USB} = \left(f_c + f_{msg} \right)$$

Example with Units

$$65.133\,\text{Hz} = \left(50.133\,\text{Hz} + 15\,\text{Hz} \right)$$

20) Upper Sideband Power Formula

Evaluate Formula

Formula

$$P_{usb} = \frac{A_c^{2} \cdot \mu^{2}}{8 \cdot R}$$

Example with Units

$$0.0374\,\text{W} = \frac{17\,\text{V}^{2} \cdot 0.36^{2}}{8 \cdot 125.25\,\Omega}$$

21) Upper Sideband Power with respect to Carrier Power Formula

Evaluate Formula

Formula

$$P_{usb} = P_c \cdot \frac{\mu^{2}}{4}$$

Example with Units

$$0.0375\,\text{W} = 1.156\,\text{W} \cdot \frac{0.36^{2}}{4}$$

Variables used in list of Sideband and Frequency Modulation Formulas above

- A_c Amplitude of Carrier Signal *(Volt)*
- A_{DSB} Amplitude of Carrier Signal DSB-SC *(Volt)*
- A_m Amplitude of Modulating Signal *(Volt)*
- $A_{m(peak)}$ Peak Amplitude of Message *(Volt)*
- BW_{DSB} Bandwidth in DSB-SC *(Hertz)*
- BW_{FM} Bandwidth of FM Wave *(Hertz)*
- $BW_{t\text{-}DSB}$ Transmission Bandwidth DSBSC *(Hertz)*
- BW_{VSB} Bandwidth of VSB *(Hertz)*
- f_c Carrier Frequency *(Hertz)*
- f_{cs} Carrier Swing *(Hertz)*
- f_{LSB} Lower Sideband Frequency *(Hertz)*
- F_m Modulating Signal Frequency *(Hertz)*
- $f_{m\text{-}DSB}$ Maximum Frequency DSB-SC *(Hertz)*
- f_{mod} Modulating Frequency *(Hertz)*
- f_{msg} Message Maximum Frequency *(Hertz)*
- f_{USB} Upper Sideband Frequency *(Hertz)*
- $f_{v\text{-}DSB}$ Vestige Frequency *(Hertz)*
- K_f Frequency Sensitivity *(Hertz)*
- K_p Proportionality Constant
- $N_{0\text{-}DSB}$ Noise Density DSB-SC *(Watt-Second)*
- P_c Carrier Power *(Watt)*
- $P_{DSB\text{-}SC}$ Total Power DSB-SC *(Watt)*
- $P_{L\text{-}DSB}$ Lower Sideband Power DSB-SC *(Watt)*
- P_{lsb} Lower Sideband Power *(Watt)*
- $P_{t\text{-}DSB}$ Transmitted Power of DSB-SC *(Watt)*
- $P_{U\text{-}DSB}$ Upper Sideband Power in DSB-SC *(Watt)*
- P_{usb} Upper Sideband Power *(Watt)*
- R Resistance *(Ohm)*

Constants, Functions, Measurements used in list of Sideband and Frequency Modulation Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- 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: **Electric Resistance** in Ohm (Ω) *Electric Resistance Unit Conversion*
- Measurement: **Electric Potential** in Volt (V) *Electric Potential Unit Conversion*
- Measurement: **Angular Frequency** in Radian per Second (rad/s) *Angular Frequency Unit Conversion*

- SNR_{pre} Pre Detection SNR of DSB-SC *(Decibel)*
- β Modulation Index in FM
- Δf Frequency Deviation *(Hertz)*
- ΔP Phase Deviation
- μ Modulation Index
- ω Angular Frequency *(Radian per Second)*

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