Important Low Frequency Response Amplifiers Formulas PDF

Formulas Examples with Units

List of 13 Important Low Frequency Response Amplifiers Formulas

1) Response Analysis Formulas

1.1) Peak Voltage of Positive Sine Wave Formula

Evaluate Formula

Formula

$$V_m = \frac{\pi \cdot P \cdot R_L}{V_i}$$

Example with Units

$$5.9847\,\mathrm{V} = \frac{3.1416 \cdot 5.08\,\mathrm{mW} \cdot 4.5\,\mathrm{k\Omega}}{12\,\mathrm{V}}$$

1.2) Power Drain from Positive Sine Wave Formula

Evaluate Formula

Formula

$$P = \frac{V_m \cdot V_i}{\pi \cdot R_L}$$

Example with Units

$$5.093\,\mathrm{mW} = \frac{6\,\mathrm{V} \cdot 12\,\mathrm{V}}{3.1416 \cdot 4.5\,\mathrm{k\Omega}}$$

1.3) Transition Frequency Formula

Evaluate Formula

Formula

$$f_{1,2} = \frac{1}{\sqrt{B}}$$

Example with Units

$$0.5\,\mathrm{Hz} = \frac{1}{\sqrt{4}}$$

1.4) Unity-Gain Bandwidth Formula

Evaluate Formula

Formula

$$\omega_T = \beta \cdot f_L$$

Example with Units

$$6300\,\mathrm{Hz} = 150 \cdot 42\,\mathrm{Hz}$$

2) Response of CE Amplifier Formulas

2.1) Resistance due to Capacitor CC1 using Method Short-Circuit Time Constants Formula

Evaluate Formula

Formula

$$R_t = \left(\frac{1}{R_b} + \frac{1}{R_i}\right) + R_s$$

Example with Units

$$4.7\,\mathrm{k\Omega} = \left(\frac{1}{14\,\mathrm{k\Omega}} + \frac{1}{16\,\mathrm{k\Omega}}\right) + 4.7\,\mathrm{k\Omega}$$

2.2) Time Constant Associated with Cc1 using Method Short-Circuit Time Constants Formula

Evaluate Formula

Formula

$$\tau = C_{C1} \cdot R'_{1}$$

Example with Units

$$2.04\,\mathrm{s} = 400\,\mathrm{\mu F} \cdot 5.1\,\mathrm{k\Omega}$$

2.3) Time Constant of CE Amplifier Formula

Evaluate Formula

Formula

$$\tau = C_{C1} \cdot R_{1}$$

Example with Units

$$1.96\,\mathrm{s} = 400\,\mathrm{\mu F} \cdot 4.9\,\mathrm{k\Omega}$$

3) Response of CS Amplifier Formulas

3.1) 3 DB Frequency of CS Amplifier without Dominant Poles Formula

Evaluate Formula

Formula

$$f_{L} = \sqrt{\omega_{p1}^{2} + f_{P}^{2} + \omega_{p3}^{2} - \left(2 \cdot f^{2}\right)}$$

Example with Units

$$42.4269\,\mathrm{Hz} = \sqrt{0.2\,\mathrm{Hz}^{2} + 80\,\mathrm{Hz}^{2} + 20\,\mathrm{Hz}^{2} - \left(2 \cdot 50\,\mathrm{Hz}^{2}\right)}$$

3.2) Frequency at Zero Transmission of CS Amplifier Formula

Evaluate Formula

Formula

$$f = \frac{g_{m}}{2 \cdot \pi \cdot C_{gd}}$$

Example with Units

$$49.7359\,\mathrm{Hz} = \frac{0.25\,\mathrm{S}}{2 \cdot 3.1416 \cdot 800\,\mathrm{\mu F}}$$

3.3) Mid-Band Gain of CS Amplifier Formula

Evaluate Formula

Formula

$$A_{mid} = -\left(\frac{R_{i}}{R_{i} + R_{s}}\right) \cdot g_{m} \cdot \left(\left(\frac{1}{R_{d}}\right) + \left(\frac{1}{R_{L}}\right)\right)$$

Example with Units

$$-0.0013 = -\left(\frac{16\,\mathrm{k\Omega}}{16\,\mathrm{k\Omega} + 4.7\,\mathrm{k\Omega}}\right) \cdot 0.25\,\mathrm{S} \cdot \left(\left(\frac{1}{0.15\,\mathrm{k\Omega}}\right) + \left(\frac{1}{4.5\,\mathrm{k\Omega}}\right)\right)$$

3.4) Output Voltage of Low Frequency Amplifier Formula

Evaluate Formula

Formula

$$V_o = V \cdot A_{mid} \cdot \left(\frac{f}{f + \omega_{p1}}\right) \cdot \left(\frac{f}{f + \omega_{p2}}\right) \cdot \left(\frac{f}{f + \omega_{p3}}\right)$$

Example with Units

$$-0.0016\,\text{V} = 2.5\,\text{V} \cdot -0.001331 \cdot \left(\frac{50\,\text{Hz}}{50\,\text{Hz} + 0.2\,\text{Hz}}\right) \cdot \left(\frac{50\,\text{Hz}}{50\,\text{Hz} + 25\,\text{Hz}}\right) \cdot \left(\frac{50\,\text{Hz}}{50\,\text{Hz} + 20\,\text{Hz}}\right)$$

3.5) Pole Frequency of Bypass Capacitor in CS Amplifier Formula

Evaluate Formula

Formula

$$\omega_{p1} = \frac{g_m + \frac{1}{R}}{C_s}$$

Example with Units

$$62.625\,\text{Hz} = \frac{0.25\,\text{S} + \frac{1}{2\,\text{k}\Omega}}{4000\,\mu\text{F}}$$

3.6) Pole Frequency of CS Amplifier Formula

Evaluate Formula

Formula

$$\omega_{p1} = \frac{1}{C_{C1} \cdot \left(R_i + R_s\right)}$$

Example with Units

$$0.1208\,\text{Hz} = \frac{1}{400\,\mu\text{F} \cdot \left(16\,\text{k}\Omega + 4.7\,\text{k}\Omega\right)}$$

Variables used in list of Low Frequency Response Amplifiers Formulas above

- A_{mid} Mid Band Gain
- B Constant B
- C_{C1} Capacitance of Coupling Capacitor 1 *(Microfarad)*
- C_{gd} Capacitance Gate to Drain *(Microfarad)*
- C_s Bypass Capacitor *(Microfarad)*
- f Frequency *(Hertz)*
- $f_{1,2}$ Transition Frequency *(Hertz)*
- f_L 3-dB Frequency *(Hertz)*
- f_P Frequency of Dominant Pole *(Hertz)*
- g_m Transconductance *(Siemens)*
- P Power Drained *(Milliwatt)*
- R Resistance *(Kilohm)*
- R_1 Resistance of Resistor 1 *(Kilohm)*
- R'_1 Resistance of Primary Winding in Secondary *(Kilohm)*
- R_b Base Resistance *(Kilohm)*
- R_d Drain Resistance *(Kilohm)*
- R_i Input Resistance *(Kilohm)*
- R_L Load Resistance *(Kilohm)*
- R_s Signal Resistance *(Kilohm)*
- R_t Total Resistance *(Kilohm)*
- V Small Signal Voltage *(Volt)*
- V_i Supply Voltage *(Volt)*
- V_m Peak Voltage *(Volt)*
- V_o Output Voltage *(Volt)*
- β Common Emitter Current Gain
- ω_{p1} Pole Frequency 1 *(Hertz)*
- ω_{p2} Pole Frequency 2 *(Hertz)*
- ω_{p3} Pole Frequency 3 *(Hertz)*
- ω_T Unity Gain Bandwidth *(Hertz)*

Constants, Functions, Measurements used in list of Low Frequency Response Amplifiers 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: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Power** in Milliwatt (mW)
  Power Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Capacitance** in Microfarad (μF)
  Capacitance Unit Conversion
- Measurement: **Electric Resistance** in Kilohm (kΩ)
  Electric Resistance Unit Conversion
- Measurement: **Electric Conductance** in Siemens (S)
  Electric Conductance Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion

- τ Time Constant *(Second)*

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