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Low Frequency Response Amplifiers Formulas

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List of 13 Low Frequency Response Amplifiers Formulas

Low Frequency Response Amplifiers

Response Analysis

1) Peak Voltage of Positive Sine Wave

Open Calculator

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

ex $$5.984734V = \frac{\pi \cdot 5.08mW \cdot 4.5k\Omega}{12V}$$

2) Power Drain from Positive Sine Wave

Open Calculator

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

ex $$5.092958mW = \frac{6V \cdot 12V}{\pi \cdot 4.5k\Omega}$$

3) Transition Frequency

Open Calculator

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

ex $$0.5Hz = \frac{1}{\sqrt{4}}$$

4) Unity-Gain Bandwidth

Open Calculator

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

ex $$6300Hz = 150 \cdot 42Hz$$

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Response of CE Amplifier

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

Open Calculator

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

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

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

Open Calculator

fx $$\tau = C_{C1} \cdot R'_1$$

ex $$2.04\text{s} = 400\mu\text{F} \cdot 5.1\text{k}\Omega$$

7) Time Constant of CE Amplifier

Open Calculator

fx $$\tau = C_{C1} \cdot R_1$$

ex $$1.96\text{s} = 400\mu\text{F} \cdot 4.9\text{k}\Omega$$

Response of CS Amplifier

8) 3 DB Frequency of CS Amplifier without Dominant Poles

Open Calculator

fx $$f_L = \sqrt{\omega_{p1}^2 + f_P^2 + \omega_{p3}^2 - \left(2 \cdot f^2\right)}$$

ex $$42.42688\text{Hz} = \sqrt{(0.2\text{Hz})^2 + (80\text{Hz})^2 + (20\text{Hz})^2 - \left(2 \cdot (50\text{Hz})^2\right)}$$

9) Frequency at Zero Transmission of CS Amplifier

Open Calculator

fx $$f = \frac{g_m}{2 \cdot \pi \cdot C_{gd}}$$

ex $$49.73592\text{Hz} = \frac{0.25\text{S}}{2 \cdot \pi \cdot 800\mu\text{F}}$$

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10) Mid-Band Gain of CS Amplifier

Open Calculator

fx $$A_{mid} = -\left(\frac{R_i}{R_i + R_s}\right) \cdot g_m \cdot \left(\left(\frac{1}{R_d}\right) + \left(\frac{1}{R_L}\right)\right)$$

ex $$-0.001331 = -\left(\frac{16k\Omega}{16k\Omega + 4.7k\Omega}\right) \cdot 0.25S \cdot \left(\left(\frac{1}{0.15k\Omega}\right) + \left(\frac{1}{4.5k\Omega}\right)\right)$$

11) Output Voltage of Low Frequency Amplifier

Open Calculator

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

ex $$-0.001578V = 2.5V \cdot -0.001331 \cdot \left(\frac{50Hz}{50Hz + 0.2Hz}\right) \cdot \left(\frac{50Hz}{50Hz + 25Hz}\right) \cdot \left(\frac{50Hz}{50Hz + 20Hz}\right)$$

12) Pole Frequency of Bypass Capacitor in CS Amplifier

Open Calculator

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

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

13) Pole Frequency of CS Amplifier

Open Calculator

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

ex $$0.120773Hz = \frac{1}{400\mu F \cdot (16k\Omega + 4.7k\Omega)}$$

Variables Used

- 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)*
- τ Time Constant *(Second)*

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Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  Square root function
- 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

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Check other formula lists

- **Amplifier Characteristics Formulas**
- **Amplifier Functions and Network Formulas**
- **BJT Differential Amplifiers Formulas**
- **Feedback Amplifiers Formulas**
- **Low Frequency Response Amplifiers Formulas**
- **MOSFET Amplifiers Formulas**
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