Important Amplifier Functions and Network Formulas PDF

Formulas
Examples
with Units

List of 15
Important Amplifier Functions and Network Formulas

1) Miller's Theorem Formulas

1.1) Change in Drain Current Formula

Evaluate Formula

Formula

$$i_d = -\frac{V_a}{Z_2}$$

Example with Units

$$-15.7273\,\text{mA} = -\frac{17.3\,\text{V}}{1.1\,\text{k}\Omega}$$

1.2) Current at Primary Node of Amplifier Formula

Evaluate Formula

Formula

$$i_1 = \frac{V_a}{Z_1}$$

Example with Units

$$173\,\text{mA} = \frac{17.3\,\text{V}}{0.1\,\text{k}\Omega}$$

1.3) Miller Capacitance Formula

Evaluate Formula

Formula

$$C_m = C_{gd} \cdot \left(1 + \frac{1}{g_m \cdot R_L}\right)$$

Example with Units

$$2.7024\,\mu\text{F} = 2.7\,\mu\text{F} \cdot \left(1 + \frac{1}{0.25\,\text{S} \cdot 4.5\,\text{k}\Omega}\right)$$

1.4) Primary Impedance in Miller Capacitance Formula

Evaluate Formula

Formula

$$Z_1 = \frac{Z_t}{1 - \left(A_v\right)}$$

Example with Units

$$0.1093\,\text{k}\Omega = \frac{1.23\,\text{k}\Omega}{1 - \left(-10.25\right)}$$

1.5) Secondary Impedance in Miller Capacitance Formula

Evaluate Formula

Formula

$$Z_2 = \frac{Z_t}{1 - \left(\frac{1}{A_v}\right)}$$

Example with Units

$$1.1207\,\text{k}\Omega = \frac{1.23\,\text{k}\Omega}{1 - \left(\frac{1}{-10.25}\right)}$$

1.6) Total Current in Miller Capacitance Formula

Evaluate Formula

Formula

$$i_t = V_p \cdot \frac{1 - \left(A_v \right)}{Z_t}$$

Example with Units

$$215.8537\,\text{mA} = 23.6\,\text{V} \cdot \frac{1 - \left(-10.25 \right)}{1.23\,\text{k}\Omega}$$

2) STC Filter Formulas

2.1) Magnitude Response of STC Network for High-Pass Filter Formula

Evaluate Formula

Formula

$$M_{hp} = \frac{\operatorname{mod} us\left(K \right)}{\sqrt{1 - \left(\frac{f_{hp}}{f_t} \right)^2}}$$

Example with Units

$$0.4903 = \frac{\operatorname{mod} us\left(0.49 \right)}{\sqrt{1 - \left(\frac{3.32\,\text{Hz}}{90\,\text{Hz}} \right)^2}}$$

2.2) Magnitude Response of STC Network for Low-Pass Filter Formula

Evaluate Formula

Formula

$$M_{Lp} = \frac{\operatorname{mod} us\left(K \right)}{\sqrt{1 + \left(\frac{f_t}{f_{hp}} \right)^2}}$$

Example with Units

$$0.0181 = \frac{\operatorname{mod} us\left(0.49 \right)}{\sqrt{1 + \left(\frac{90\,\text{Hz}}{3.32\,\text{Hz}} \right)^2}}$$

2.3) Phase Response Angle of STC Network for High-Pass Filter Formula

Evaluate Formula

Formula

$$\angle T_{j\omega} = \arctan\left(\frac{f_{hp}}{f_t} \right)$$

Example with Units

$$2.1126° = \arctan\left(\frac{3.32\,\text{Hz}}{90\,\text{Hz}} \right)$$

2.4) Time Constant of STC Network Formula

Evaluate Formula

Formula

$$\tau = \frac{L_H}{R_L}$$

Example with Units

$$2.0556\,\text{ms} = \frac{9.25\,\text{H}}{4.5\,\text{k}\Omega}$$

3) STC Network Formulas

3.1) Input Capacitance of STC Circuit Formula

Evaluate Formula

Formula

$$C_{stc} = C_t + C_{gs}$$

Example with Units

$$5.7\,\mu\text{F} = 4\,\mu\text{F} + 1.70\,\mu\text{F}$$

3.2) Input Capacitance with reference to Corner Frequency Formula

Evaluate Formula

Formula

$$C_{in} = \frac{1}{f_{stc} \cdot R_{sig}}$$

Example with Units

$$200.3205\,\mu F = \frac{1}{4.16\,Hz \cdot 1.2\,k\Omega}$$

3.3) Pole Frequency of STC Circuit Formula

Evaluate Formula

Formula

$$f_{stc} = \frac{1}{C_{in} \cdot R_{sig}}$$

Example with Units

$$4.1667\,Hz = \frac{1}{200\,\mu F \cdot 1.2\,k\Omega}$$

3.4) Pole Frequency of STC Circuit for High-Pass Formula

Evaluate Formula

Formula

$$f_{hp} = \frac{1}{\left(C_{be} + C_{bj}\right) \cdot R_{in}}$$

Example with Units

$$3.2926\,Hz = \frac{1}{\left(100.75\,\mu F + 150.25\,\mu F\right) \cdot 1.21\,k\Omega}$$

3.5) Pole Frequency of STC Networks for Low-Pass Formula

Evaluate Formula

Formula

$$f_{Lp} = \frac{1}{\tau}$$

Example with Units

$$487.8049\,Hz = \frac{1}{2.05\,ms}$$

Variables used in list of Amplifier Functions and Network Formulas above

- $\angle T_{j\omega}$ Phase Angle of STC *(Degree)*
- A_v Voltage Gain
- C_{be} Emitter-Base Capacitance *(Microfarad)*
- C_{bj} Collector-Base Junction Capacitance *(Microfarad)*
- C_{gd} Gate to Drain Capacitance *(Microfarad)*
- C_{gs} Gate to Source Capacitance *(Microfarad)*
- C_{in} Input Capacitance *(Microfarad)*
- C_m Miller Capacitance *(Microfarad)*
- C_{stc} Input Capacitance of STC *(Microfarad)*
- C_t Total Capacitance *(Microfarad)*
- f_{hp} Pole Frequency High Pass *(Hertz)*
- f_{Lp} Pole Frequency Low Pass *(Hertz)*
- f_{stc} Pole Frequency of STC Filter *(Hertz)*
- f_t Total Pole Frequency *(Hertz)*
- g_m Transconductance *(Siemens)*
- i_1 Current in Primary Conductor *(Milliampere)*
- i_d Change in Drain Current *(Milliampere)*
- i_t Total Current *(Milliampere)*
- K DC Gain
- L_H Load Inductance *(Henry)*
- M_{hp} Magnitude Response of High Pass Filter
- M_{Lp} Magnitude Response of Low-Pass Filter
- R_{in} Finite Input Resistance *(Kilohm)*
- R_L Load Resistance *(Kilohm)*
- R_{sig} Signal Resistance *(Kilohm)*
- V_a A-Phase Voltage *(Volt)*
- V_p Primary Voltage *(Volt)*
- Z_1 Impedance of Primary Winding *(Kilohm)*
- Z_2 Impedance of Secondary Winding *(Kilohm)*

Constants, Functions, Measurements used in list of Amplifier Functions and Network Formulas above

- Functions: **arctan**, arctan(Number)
  Inverse trigonometric functions are usually accompanied by the prefix - arc. Mathematically, we represent arctan or the inverse tangent function as tan-1 x or arctan(x).
- Functions: **ctan**, ctan(Angle)
  Cotangent is a trigonometric function that is defined as the ratio of the adjacent side to the opposite side in a right triangle.
- Functions: **modulus**, modulus
  Modulus of a number is the remainder when that number is divided by another number.
- 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.
- Functions: **tan**, tan(Angle)
  The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- Measurement: **Time** in Millisecond (ms)
  Time Unit Conversion
- Measurement: **Electric Current** in Milliampere (mA)
  Electric Current Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle 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: **Inductance** in Henry (H)
  Inductance Unit Conversion

- Z_t Total Impedance *(Kilohm)*
- τ Time Constant *(Millisecond)*

- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion

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