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# Amplifier Functions and Network Formulas

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# List of 15 Amplifier Functions and Network Formulas

## Amplifier Functions and Network

### Miller's Theorem

#### 1) Change in Drain Current

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

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

$$\text{ex } -15.727273\text{mA} = -\frac{17.3\text{V}}{1.1\text{k}\Omega}$$

#### 2) Current at Primary Node of Amplifier

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

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

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



### 3) Miller Capacitance

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

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

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

### 4) Primary Impedance in Miller Capacitance

$$\text{fx } Z_1 = \frac{Z_t}{1 - (A_v)}$$

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

$$\text{ex } 0.109333\text{k}\Omega = \frac{1.23\text{k}\Omega}{1 - (-10.25)}$$

### 5) Secondary Impedance in Miller Capacitance

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

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

$$\text{ex } 1.120667\text{k}\Omega = \frac{1.23\text{k}\Omega}{1 - \left( \frac{1}{-10.25} \right)}$$



## 6) Total Current in Miller Capacitance

$$fx \quad i_t = V_p \cdot \frac{1 - (A_v)}{Z_t}$$

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

$$ex \quad 215.8537mA = 23.6V \cdot \frac{1 - (-10.25)}{1.23k\Omega}$$

## STC Filter

### 7) Magnitude Response of STC Network for High-Pass Filter

$$fx \quad M_{hp} = \frac{\text{modulus}(K)}{\sqrt{1 - \left(\frac{f_{hp}}{f_t}\right)^2}}$$

[Open Calculator !\[\]\(aa53ad6fea213b8b2226d3077e30533a\_img.jpg\)](#)

$$ex \quad 0.490334 = \frac{\text{modulus}(0.49)}{\sqrt{1 - \left(\frac{3.32Hz}{90Hz}\right)^2}}$$

### 8) Magnitude Response of STC Network for Low-Pass Filter

$$fx \quad M_{Lp} = \frac{\text{modulus}(K)}{\sqrt{1 + \left(\frac{f_t}{f_{hp}}\right)^2}}$$

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a\_img.jpg\)](#)

$$ex \quad 0.018063 = \frac{\text{modulus}(0.49)}{\sqrt{1 + \left(\frac{90Hz}{3.32Hz}\right)^2}}$$



## 9) Phase Response Angle of STC Network for High-Pass Filter

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

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

$$\text{ex } 2.11262^\circ = \arctan\left(\frac{3.32\text{Hz}}{90\text{Hz}}\right)$$

## 10) Time Constant of STC Network

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

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

$$\text{ex } 2.055556\text{ms} = \frac{9.25\text{H}}{4.5\text{k}\Omega}$$

## STC Network

### 11) Input Capacitance of STC Circuit

$$\text{fx } C_{stc} = C_t + C_{gs}$$

[Open Calculator !\[\]\(0fb13ad0bfa3d86868cdd3883e5665b3\_img.jpg\)](#)

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

### 12) Input Capacitance with reference to Corner Frequency

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

[Open Calculator !\[\]\(e50091943b385fe16d3277389202856f\_img.jpg\)](#)

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



### 13) Pole Frequency of STC Circuit

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

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

$$ex \quad 4.166667Hz = \frac{1}{200\mu F \cdot 1.2k\Omega}$$

### 14) Pole Frequency of STC Circuit for High-Pass

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

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

$$ex \quad 3.292615Hz = \frac{1}{(100.75\mu F + 150.25\mu F) \cdot 1.21k\Omega}$$

### 15) Pole Frequency of STC Networks for Low-Pass

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

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

$$ex \quad 487.8049Hz = \frac{1}{2.05ms}$$



## Variables Used

- $\angle T_{j\omega}$  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)
- $Z_t$  Total Impedance (Kilohm)
- $T$  Time Constant (Millisecond)





## Constants, Functions, Measurements used

- **Function: arctan**, arctan(Number)  
*Inverse trigonometric tangent function*
- **Function: ctan**, ctan(Angle)  
*Trigonometric cotangent function*
- **Function: modulus**, modulus  
*Modulus of number*
- **Function: sqrt**, sqrt(Number)  
*Square root function*
- **Function: tan**, tan(Angle)  
*Trigonometric tangent function*
- **Measurement: Time** in Millisecond (ms)  
*Time Unit Conversion* 
- **Measurement: Electric Current** in Milliampere (mA)  
*Electric Current Unit Conversion* 
- **Measurement: Angle** in Degree ( $^{\circ}$ )  
*Angle Unit Conversion* 
- **Measurement: Frequency** in Hertz (Hz)  
*Frequency Unit Conversion* 
- **Measurement: Capacitance** in Microfarad ( $\mu\text{F}$ )  
*Capacitance Unit Conversion* 
- **Measurement: Electric Resistance** in Kilohm ( $\text{k}\Omega$ )  
*Electric Resistance Unit Conversion* 
- **Measurement: Electric Conductance** in Siemens (S)  
*Electric Conductance Unit Conversion* 
- **Measurement: Inductance** in Henry (H)  
*Inductance Unit Conversion* 



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



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- [Amplifier Functions and Network Formulas](#) 
- [BJT Differential Amplifiers Formulas](#) 
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