

Important Common Stage Amplifiers Formulas PDF

Formulas
Examples
with Units

List of 26 Important Common Stage Amplifiers Formulas

1) Amplifier Bandwidth in Discrete-Circuit Amplifier Formula

Formula

$$BW = f_h - f_L$$

Example with Units

$$0.25 \text{ Hz} = 100.50 \text{ Hz} - 100.25 \text{ Hz}$$

Evaluate Formula 

2) Bypass Capacitance of CS Amplifier Formula

Formula

$$C_s = \frac{1}{f_{tm} \cdot R_{sig}}$$

Example with Units

$$25.9994 \mu\text{F} = \frac{1}{30.77 \text{ Hz} \cdot 1.25 \text{ k}\Omega}$$

Evaluate Formula 

3) Collector Base Junction Resistance of CE Amplifier Formula

Formula

$$R_c = R_{sig} \cdot (1 + g_m \cdot R_L) + R_L$$

Example with Units

$$11.68 \text{ k}\Omega = 1.25 \text{ k}\Omega \cdot (1 + 4.8 \text{ mS} \cdot 1.49 \text{ k}\Omega) + 1.49 \text{ k}\Omega$$

Evaluate Formula 

4) Current Gain of CS Amplifier Formula

Formula

$$A_i = \frac{A_p}{A_v}$$

Example

$$3.6984 = \frac{3.691}{0.998}$$

Evaluate Formula 

5) Drain Voltage through Method of Open-Circuit Time Constants to CS Amplifier Formula

Formula

$$V_d = V_x + V_{gs}$$

Example with Units

$$15.32 \text{ V} = 11.32 \text{ V} + 4 \text{ V}$$

Evaluate Formula 

6) Effective High Frequency Time Constant of CE Amplifier Formula

Formula

$$\tau_H = C_{be} \cdot R_{sig} + \left(C_{cb} \cdot \left(R_{sig} \cdot \left(1 + g_m \cdot R_L \right) + R_L \right) \right) + \left(C_t \cdot R_L \right)$$

Example with Units

$$3.5421 \text{ s} = 27 \mu\text{F} \cdot 1.25 \text{ k}\Omega + \left(300 \mu\text{F} \cdot \left(1.25 \text{ k}\Omega \cdot \left(1 + 4.8 \text{ mS} \cdot 1.49 \text{ k}\Omega \right) + 1.49 \text{ k}\Omega \right) \right) + \left(2.889 \mu\text{F} \cdot 1.49 \text{ k}\Omega \right)$$



7) Equivalent Signal Resistance of CS Amplifier Formula ↗

Formula

$$R'_{\text{sig}} = \frac{1}{\left(\frac{1}{R_{\text{sig}}} + \frac{1}{R_{\text{out}}} \right)}$$

Example with Units

$$0.6835 \text{ k}\Omega = \frac{1}{\left(\frac{1}{1.25 \text{ k}\Omega} + \frac{1}{1.508 \text{ k}\Omega} \right)}$$

[Evaluate Formula ↗](#)

8) Frequency of Zero Transmission of CS Amplifier Formula ↗

Formula

$$f_{\text{tm}} = \frac{1}{C_s \cdot R_{\text{sig}}}$$

Example with Units

$$30.7692 \text{ Hz} = \frac{1}{26 \mu\text{F} \cdot 1.25 \text{ k}\Omega}$$

[Evaluate Formula ↗](#)

9) High-Frequency Band given Complex Frequency Variable Formula ↗

Formula

$$A_m = \sqrt{\frac{\left(1 + \left(\frac{f_{3dB}}{f_t} \right) \right) \cdot \left(1 + \left(\frac{f_{3dB}}{f_o} \right) \right)}{\left(1 + \left(\frac{f_{3dB}}{f_p} \right) \right) \cdot \left(1 + \left(\frac{f_{3dB}}{f_{p2}} \right) \right)}}$$

Example with Units

$$12.1915 \text{ dB} = \sqrt{\frac{\left(1 + \left(\frac{50 \text{ Hz}}{36.75 \text{ Hz}} \right) \right) \cdot \left(1 + \left(\frac{50 \text{ Hz}}{0.112 \text{ Hz}} \right) \right)}{\left(1 + \left(\frac{50 \text{ Hz}}{36.532 \text{ Hz}} \right) \right) \cdot \left(1 + \left(\frac{50 \text{ Hz}}{25 \text{ Hz}} \right) \right)}}$$

[Evaluate Formula ↗](#)

10) High-Frequency Gain of CE Amplifier Formula ↗

Formula

$$A_{hf} = \frac{f_{u3dB}}{2 \cdot \pi}$$

Example with Units

$$0.2001 = \frac{1.257 \text{ Hz}}{2 \cdot 3.1416}$$

[Evaluate Formula ↗](#)

11) High-Frequency Response given Input Capacitance Formula ↗

Formula

$$A_{hf} = \frac{1}{2 \cdot \pi \cdot R_{\text{sig}} \cdot C_i}$$

Example with Units

$$0.2443 = \frac{1}{2 \cdot 3.1416 \cdot 1.25 \text{ k}\Omega \cdot 521.27 \mu\text{F}}$$

[Evaluate Formula ↗](#)

12) Input Capacitance in High-Frequency Gain of CE Amplifier Formula ↗

Formula

$$C_i = C_{cb} + C_{be} \cdot \left(1 + \left(g_m \cdot R_L \right) \right)$$

Example with Units

$$520.104 \mu\text{F} = 300 \mu\text{F} + 27 \mu\text{F} \cdot \left(1 + \left(4.8 \text{ mS} \cdot 1.49 \text{ k}\Omega \right) \right)$$

[Evaluate Formula ↗](#)

13) Input Resistance of CG Amplifier Formula

Formula

$$R_t = \frac{R_{in} + R_L}{1 + (g_m \cdot R_{in})}$$

Example with Units

$$0.4785\text{k}\Omega = \frac{0.78\text{k}\Omega + 1.49\text{k}\Omega}{1 + (4.8\text{mS} \cdot 0.78\text{k}\Omega)}$$

Evaluate Formula 

14) Load Resistance of CG Amplifier Formula

Formula

$$R_L = R_t \cdot (1 + (g_m \cdot R_{in})) - R_{in}$$

Evaluate Formula **Example with Units**

$$1.4971\text{k}\Omega = 0.480\text{k}\Omega \cdot (1 + (4.8\text{mS} \cdot 0.78\text{k}\Omega)) - 0.78\text{k}\Omega$$

15) Load Resistance of CS Amplifier Formula

Formula

$$R_L = \left(\frac{V_{out}}{g_m \cdot V_{gs}} \right)$$

Example with Units

$$1.499\text{k}\Omega = \left(\frac{28.78\text{v}}{4.8\text{mS} \cdot 4\text{v}} \right)$$

Evaluate Formula 

16) Mid Band Gain of CE Amplifier Formula

Formula

$$A_{mid} = \frac{V_{out}}{V_{th}}$$

Example with Units

$$32.0133 = \frac{28.78\text{v}}{0.899\text{v}}$$

Evaluate Formula 

17) Midband Gain of CS Amplifier Formula

Formula

$$A_{mid} = \frac{V_{out}}{V_{sig}}$$

Example with Units

$$32.0133 = \frac{28.78\text{v}}{0.899\text{v}}$$

Evaluate Formula 

18) Open Circuit Time Constant between Gate and Drain of Common Gate Amplifier Formula

Formula

$$T_{oc} = (C_t + C_{gd}) \cdot R_L$$

Example with Units

$$0.0063\text{s} = (2.889\mu\text{F} + 1.345\mu\text{F}) \cdot 1.49\text{k}\Omega$$

Evaluate Formula 

19) Open Circuit Time Constant in High Frequency Response of CG Amplifier Formula ↗

Formula

Evaluate Formula ↗

$$T_{oc} = C_{gs} \cdot \left(\frac{1}{R_{sig}} + g_m \right) + (C_t + C_{gd}) \cdot R_L$$

Example with Units

$$0.0063 \text{ s} = 2.6 \mu\text{F} \cdot \left(\frac{1}{1.25 \text{ k}\Omega} + 4.8 \text{ mS} \right) + (2.889 \mu\text{F} + 1.345 \mu\text{F}) \cdot 1.49 \text{ k}\Omega$$

20) Output Voltage of CS Amplifier Formula ↗

Formula

Example with Units

Evaluate Formula ↗

$$V_{out} = g_m \cdot V_{gs} \cdot R_L$$

$$28.608 \text{ V} = 4.8 \text{ mS} \cdot 4 \text{ V} \cdot 1.49 \text{ k}\Omega$$

21) Resistance between Gate and Drain in Open Circuit Time Constants Method of CS Amplifier Formula ↗

Formula

Example with Units

Evaluate Formula ↗

$$R_t = \frac{V_x}{i_x}$$

$$0.3861 \text{ k}\Omega = \frac{11.32 \text{ V}}{29.32 \text{ mA}}$$

22) Resistance between Gate and Source of CG Amplifier Formula ↗

Formula

Example with Units

Evaluate Formula ↗

$$R_t = \frac{1}{\frac{1}{R_{in}} + \frac{1}{R_{sig}}}$$

$$0.4803 \text{ k}\Omega = \frac{1}{\frac{1}{0.78 \text{ k}\Omega} + \frac{1}{1.25 \text{ k}\Omega}}$$

23) Second Pole-Frequency of CG Amplifier Formula ↗

Formula

Evaluate Formula ↗

$$f_{p2} = \frac{1}{2 \cdot \pi \cdot R_L \cdot (C_{gd} + C_t)}$$

Example with Units

$$25.228 \text{ Hz} = \frac{1}{2 \cdot 3.1416 \cdot 1.49 \text{ k}\Omega \cdot (1.345 \mu\text{F} + 2.889 \mu\text{F})}$$

24) Source Voltage of CS Amplifier Formula ↗

Formula

Example with Units

Evaluate Formula ↗

$$V_{gs} = V_d - V_x$$

$$4 \text{ V} = 15.32 \text{ V} - 11.32 \text{ V}$$



25) Test Current in Open Circuit Time Constants Method of CS Amplifier Formula

Formula

$$i_x = g_m \cdot V_{gs} + \frac{v_x + V_{gs}}{R_L}$$

Example with Units

$$29.4819 \text{ mA} = 4.8 \text{ mS} \cdot 4 \text{ V} + \frac{11.32 \text{ V} + 4 \text{ V}}{1.49 \text{ k}\Omega}$$

Evaluate Formula 

26) Upper 3dB Frequency of CE Amplifier Formula

Formula

$$f_{u3dB} = 2 \cdot \pi \cdot A_{hf}$$

Example with Units

$$1.2566 \text{ Hz} = 2 \cdot 3.1416 \cdot 0.20$$

Evaluate Formula 



Variables used in list of Common Stage Amplifiers Formulas above

- A_{hf} High Frequency Response
- A_i Current Gain
- A_m Amplifier Gain in Mid Band (Decibel)
- A_{mid} Mid Band Gain
- A_p Power Gain
- A_v Voltage Gain
- BW Amplifier Bandwidth (Hertz)
- C_{be} Base Emitter Capacitance (Microfarad)
- C_{cb} Collector Base Junction Capacitance (Microfarad)
- C_{gd} Gate to Drain Capacitance (Microfarad)
- C_{gs} Gate to Source Capacitance (Microfarad)
- C_i Input Capacitance (Microfarad)
- C_s Bypass Capacitor (Microfarad)
- C_t Capacitance (Microfarad)
- f_{3dB} 3 dB Frequency (Hertz)
- f_h High Frequency (Hertz)
- f_L Low Frequency (Hertz)
- f_o Frequency Observed (Hertz)
- f_p Pole Frequency (Hertz)
- f_{p2} Second Pole Frequency (Hertz)
- f_t Frequency (Hertz)
- f_{tm} Transmission Frequency (Hertz)
- f_{u3dB} Upper 3-dB Frequency (Hertz)
- g_m Transconductance (Millisiemens)
- i_x Test Current (Milliampere)
- R_c Collector Resistance (Kilohm)
- R_{in} Finite Input Resistance (Kilohm)
- R_L Load Resistance (Kilohm)
- R_{out} Output Resistance (Kilohm)
- R_{sig} Signal Resistance (Kilohm)

Constants, Functions, Measurements used in list of Common Stage Amplifiers Formulas above

- **constant(s):** π ,
3.14159265358979323846264338327950288
Archimedes' constant
- **Functions:** \sqrt{x} , \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:** **Electric Current** in Milliampere (mA)
Electric Current Unit Conversion ↗
- **Measurement:** **Frequency** in Hertz (Hz)
Frequency Unit Conversion ↗
- **Measurement:** **Capacitance** in Microfarad (μF)
Capacitance Unit Conversion ↗
- **Measurement:** **Electric Resistance** in Kilohm ($k\Omega$)
Electric Resistance Unit Conversion ↗
- **Measurement:** **Electric Conductance** in Millisiemens (mS)
Electric Conductance Unit Conversion ↗
- **Measurement:** **Electric Potential** in Volt (V)
Electric Potential Unit Conversion ↗
- **Measurement:** **Sound** in Decibel (dB)
Sound Unit Conversion ↗



- R'_{sig} Internal Small Signal Resistance (*Kilohm*)
- R_t Resistance (*Kilohm*)
- T_{oc} Open Circuit Time Constant (*Second*)
- V_d Drain Voltage (*Volt*)
- V_{gs} Gate to Source Voltage (*Volt*)
- V_{out} Output Voltage (*Volt*)
- V'_{sig} Small Signal Voltage (*Volt*)
- V_{th} Threshold Voltage (*Volt*)
- V_x Test Voltage (*Volt*)
- τ_H Effective High Frequency Time Constant (*Second*)

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