Important Common Stage Amplifiers Gain Formulas PDF

Formulas
Examples
with Units

List of 13
Important Common Stage Amplifiers Gain Formulas

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1) Common Base Current Gain Formula

Formula

$$\alpha = \left(A_v \cdot \frac{R_e}{R_c} \right)$$

Example with Units

$$0.2793 = \left(4.21 \cdot \frac{0.067\,\text{k}\Omega}{1.01\,\text{k}\Omega} \right)$$

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2) Current Gain of Controlled Source Transistor Formula

Formula

$$A_i = \frac{1}{1 + \frac{1}{g_{mp} \cdot R_{dg}}}$$

Example with Units

$$0.8259 = \frac{1}{1 + \frac{1}{19.77\,\text{mS} \cdot 0.24\,\text{k}\Omega}}$$

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3) Emitter Voltage with respect to Voltage Gain Formula

Formula

$$V_e = \frac{V_c}{A_v}$$

Example with Units

$$24.5653\,\text{v} = \frac{103.42\,\text{v}}{4.21}$$

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4) Negative Voltage Gain from Base to Collector Formula

Formula

$$A_{vn} = -\alpha \cdot \left(\frac{R_c}{R_e} \right)$$

Example with Units

$$-4.0701 = -0.27 \cdot \left(\frac{1.01\,\text{k}\Omega}{0.067\,\text{k}\Omega} \right)$$

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5) Open-Circuit Voltage Gain of CS Amplifier Formula

Formula

$$A_{oc} = \frac{R_{out}}{R_{out} + \frac{1}{g_{mp}}}$$

Example with Units

$$0.8737 = \frac{0.35\,\text{k}\Omega}{0.35\,\text{k}\Omega + \frac{1}{19.77\,\text{mS}}}$$

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6) Overall Feedback Voltage Gain of Common-Collector Amplifier Formula

Formula

$$G_v = \frac{(\beta + 1) \cdot R_L}{(\beta + 1) \cdot R_L + (\beta + 1) \cdot R_e + R_{sig}}$$

Example with Units

$$0.8687 = \frac{(12 + 1) \cdot 1.013\,k\Omega}{(12 + 1) \cdot 1.013\,k\Omega + (12 + 1) \cdot 0.067\,k\Omega + 1.12\,k\Omega}$$

7) Overall Feedback Voltage Gain of Common-Emitter Amplifier Formula

Formula

$$G_{fv} = -\alpha \cdot \frac{R_c}{R_e} \cdot \left(\frac{R_{in}}{R_{in} + R_{sig}} \right)$$

Example with Units

$$-0.8621 = -0.27 \cdot \frac{1.01\,k\Omega}{0.067\,k\Omega} \cdot \left(\frac{0.301\,k\Omega}{0.301\,k\Omega + 1.12\,k\Omega} \right)$$

8) Overall Feedback Voltage Gain of Common-Source Amplifier Formula

Formula

$$G_{fv} = -g_{mp} \cdot \left(\frac{R_{in}}{R_{in} + R_{sig}} \right) \cdot \left(\frac{1}{R_d} + \frac{1}{R_L} + \frac{1}{R_{out}} \right)^{-1}$$

Example with Units

$$-0.6324 = -19.77\,mS \cdot \left(\frac{0.301\,k\Omega}{0.301\,k\Omega + 1.12\,k\Omega} \right) \cdot \left(\frac{1}{0.36\,k\Omega} + \frac{1}{1.013\,k\Omega} + \frac{1}{0.35\,k\Omega} \right)^{-1}$$

9) Overall Voltage Gain of Common-Emitter Amplifier Formula

Formula

$$G_{fv} = -g_{mp} \cdot \left(\frac{R_{in}}{R_{in} + R_{sig}} \right) \cdot \left(\frac{1}{R_c} + \frac{1}{R_L} + \frac{1}{R_{out}} \right)^{-1}$$

Example with Units

$$-0.8662 = -19.77\,mS \cdot \left(\frac{0.301\,k\Omega}{0.301\,k\Omega + 1.12\,k\Omega} \right) \cdot \left(\frac{1}{1.01\,k\Omega} + \frac{1}{1.013\,k\Omega} + \frac{1}{0.35\,k\Omega} \right)^{-1}$$

10) Overall Voltage Gain of Source Follower Formula

Formula

$$G_v = \frac{R_L}{R_L + \frac{1}{g_{mp}}}$$

Example with Units

$$0.9524 = \frac{1.013\,k\Omega}{1.013\,k\Omega + \frac{1}{19.77\,mS}}$$

Evaluate Formula

11) Total Current Gain with respect to Voltage Gain Formula ➤

Formula

$$\alpha = \frac{G_v}{\dfrac{R_c}{R_e} \cdot \left(\dfrac{R_{in}}{R_{in} + R_{sig}} \right)}$$

Example with Units

$$0.2693 = \frac{0.86}{\dfrac{1.01\,k\Omega}{0.067\,k\Omega} \cdot \left(\dfrac{0.301\,k\Omega}{0.301\,k\Omega + 1.12\,k\Omega} \right)}$$

12) Total Voltage Gain of CS Amplifier Formula ➤

Formula

$$A_v = \frac{V_L}{V_{in}}$$

Example with Units

$$4.208 = \frac{10.52\,v}{2.5\,v}$$

13) Voltage Gain of Common-Base Amplifier Formula ➤

Formula

$$A_v = \frac{V_c}{V_e}$$

Example with Units

$$4.2109 = \frac{103.42\,v}{24.56\,v}$$

Variables used in list of Common Stage Amplifiers Gain Formulas above

- A_i Current Gain
- A_{oc} Open Circuit Voltage Gain
- A_v Voltage Gain
- A_{vn} Negative Voltage Gain
- G_{fv} Feedback Voltage Gain
- g_{mp} MOSFET Primary Transconductance *(Millisiemens)*
- G_v Overall Voltage Gain
- R_c Collector Resistance *(Kilohm)*
- R_d Drain Resistance *(Kilohm)*
- R_{dg} Resistance between Drain and Ground *(Kilohm)*
- R_e Emitter Resistance *(Kilohm)*
- R_{in} Input Resistance *(Kilohm)*
- R_L Load Resistance *(Kilohm)*
- R_{out} Finite Output Resistance *(Kilohm)*
- R_{sig} Signal Resistance *(Kilohm)*
- V_c Collector Voltage *(Volt)*
- V_e Emitter Voltage *(Volt)*
- V_{in} Input Voltage *(Volt)*
- V_L Load Voltage *(Volt)*
- α Common Base Current Gain
- β Collector Base Current Gain

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

- Measurement: **Electric Resistance** in Kilohm (kΩ)
  Electric Resistance Unit Conversion ↗
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion ↗
- Measurement: **Transconductance** in Millisiemens (mS)
  Transconductance Unit Conversion ↗

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