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Multi Stage Transistor Amplifiers Formulas

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List of 15 Multi Stage Transistor Amplifiers Formulas

Multi Stage Transistor Amplifiers

1) Base Resistance across Emitter follower Junction

Open Calculator

fx $R_b = h_{fc} \cdot R_e$

ex $1.13163\text{k}\Omega = 16.89 \cdot 0.067\text{k}\Omega$

2) Collector Current in Active Region when Transistor Acts as Amplifier

Open Calculator

fx $i_c = i_s \cdot e^{\frac{V_{be}}{V_t}}$

ex $39.44194\text{mA} = 0.01\text{mA} \cdot e^{\frac{16.56\text{V}}{2\text{V}}}$

3) Collector Current of Emitter Follower Transistor

Open Calculator

fx $i_c = \frac{V_a{'}}{R_{out}}$

ex $39.57143\text{mA} = \frac{13.85\text{V/m}}{0.35\text{k}\Omega}$

4) Drain Resistance of Cascode Amplifier

Open Calculator

fx $$R_d = \left(\frac{A_{vo}}{g_{mp}^2 \cdot R_{out}} \right)$$

ex $$0.360457\text{k}\Omega = \left(\frac{49.31}{(19.77\text{mS})^2 \cdot 0.35\text{k}\Omega} \right)$$

5) Equivalent Resistance of Cascode Amplifier

Open Calculator

fx $$R_{dg} = \left(\frac{1}{R_{out1}} + \frac{1}{R_{in}} \right)^{-1}$$

ex $$0.24068\text{k}\Omega = \left(\frac{1}{1.201\text{k}\Omega} + \frac{1}{0.301\text{k}\Omega} \right)^{-1}$$

6) Input Resistance of Emitter Follower

Open Calculator

fx $$R_{in} = \frac{1}{\frac{1}{R_{sb}} + \frac{1}{R_b}}$$

ex $$0.306426\text{k}\Omega = \frac{1}{\frac{1}{0.41\text{k}\Omega} + \frac{1}{1.213\text{k}\Omega}}$$

7) Input Resistance of Transistor Amplifier

Open Calculator

fx $$R_{in} = \frac{V_{ip}}{i_{in}}$$

ex $$0.304\text{k}\Omega = \frac{0.152\text{V}}{0.5\text{mA}}$$

8) Input Voltage of Emitter Follower

Open Calculator

fx $$V_e = V_b - 0.7$$

ex $$24.577\text{V} = 25.277\text{V} - 0.7$$

9) Negative Voltage Gain of Cascode Amplifier

Open Calculator

fx $$A_{vn} = -\left(g_{mp} \cdot R_{dg}\right)$$

ex $$-4.7448 = -(19.77\text{mS} \cdot 0.24\text{k}\Omega)$$

10) Open Circuit Bipolar Cascode Voltage Gain

Open Calculator

fx $$A_{fo} = -g_{mp} \cdot (g_{ms} \cdot R_{out}) \cdot \left(\frac{1}{R_{out1}} + \frac{1}{R_{sm}}\right)^{-1}$$

ex $$-49.318032 = -19.77\text{mS} \cdot (10.85\text{mS} \cdot 0.35\text{k}\Omega) \cdot \left(\frac{1}{1.201\text{k}\Omega} + \frac{1}{1.45\text{k}\Omega}\right)^{-1}$$

11) Output Resistance of Emitter Follower

Open Calculator

$$R_{fi} = \left(\frac{1}{R_L} + \frac{1}{V_{sig}} + \frac{1}{R_e}\right) + \frac{\frac{1}{Z_{base}} + \frac{1}{R_{sig}}}{\beta + 1}$$

$$0.06425\text{k}\Omega = \left(\frac{1}{1.013\text{k}\Omega} + \frac{1}{7.58\text{V}} + \frac{1}{0.067\text{k}\Omega}\right) + \frac{\frac{1}{1.2\text{E}\hat{}\text{-}6\text{k}\Omega} + \frac{1}{1.12\text{k}\Omega}}{12 + 1}$$

12) Output Resistance of Transistor at Intrinsic Gain

Open Calculator

$$R_{out} = \frac{V_a{}'}{i_c}$$

$$0.350455\text{k}\Omega = \frac{13.85\text{V/m}}{39.52\text{mA}}$$

13) Output voltage gain of MOS Cascode Amplifier

Open Calculator

$$A_{vo} = -g_{mp}^2 \cdot R_{out} \cdot R_d$$

$$49.24747 = -(19.77\text{mS})^2 \cdot 0.35\text{k}\Omega \cdot 0.36\text{k}\Omega$$

14) Saturation Current of Emitter Follower

Open Calculator

$$i_s = \frac{i_c}{e^{\frac{V_{be}}{V_t}}}$$

$$0.01002\text{mA} = \frac{39.52\text{mA}}{e^{\frac{16.56\text{V}}{2\text{V}}}}$$

15) Total Emitter Resistance of Emitter Follower

Open Calculator

fx $$R_e = \frac{R_b}{h_{fc}}$$

ex $$0.071818\text{k}\Omega = \frac{1.213\text{k}\Omega}{16.89}$$

Variables Used

- A_{fo} Bipolar Cascode Voltage Gain
- A_{vn} Negative Voltage Gain
- A_{vo} Output Voltage Gain
- g_{mp} MOSFET Primary Transconductance *(Millisiemens)*
- g_{ms} MOSFET Secondary Transconductance *(Millisiemens)*
- h_{fc} High Frequency Constant
- i_c Collector Current *(Milliampere)*
- i_{in} Input Current *(Milliampere)*
- i_s Saturation Current *(Milliampere)*
- R_b Base Resistance *(Kilohm)*
- R_d Drain Resistance *(Kilohm)*
- R_{dg} Resistance between Drain and Ground *(Kilohm)*
- R_e Emitter Resistance *(Kilohm)*
- R_{fi} Finite Resistance *(Kilohm)*
- R_{in} Input Resistance *(Kilohm)*
- R_L Load Resistance *(Kilohm)*
- R_{out} Finite Output Resistance *(Kilohm)*
- R_{out1} Finite Output Resistance of Transistor 1 *(Kilohm)*
- R_{sb} Signal Resistance in Base *(Kilohm)*
- R_{sig} Signal Resistance *(Kilohm)*
- R_{sm} Small Signal Input Resistance *(Kilohm)*

- V_a' Early Voltage *(Volt per Meter)*
- V_b Base Voltage *(Volt)*
- V_{be} Voltage across Base Emitter Junction *(Volt)*
- V_e Emitter Voltage *(Volt)*
- V_{ip} Amplifier Input *(Volt)*
- V_{sig} Small Signal Voltage *(Volt)*
- V_t Threshold Voltage *(Volt)*
- Z_{base} Base Impedance *(Kilohm)*
- β Collector Base Current Gain

Constants, Functions, Measurements used

- Constant: **e**, 2.71828182845904523536028747135266249
  Napier's constant
- Measurement: **Electric Current** in Milliampere (mA)
  Electric Current Unit Conversion
- Measurement: **Electric Resistance** in Kilohm (kΩ)
  Electric Resistance Unit Conversion
- Measurement: **Electric Conductance** in Millisiemens (mS)
  Electric Conductance Unit Conversion
- Measurement: **Electric Field Strength** in Volt per Meter (V/m)
  Electric Field Strength Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion
- Measurement: **Transconductance** in Millisiemens (mS)
  Transconductance Unit Conversion

Check other formula lists

- **Common Stage Amplifiers Gain Formulas**
- **CV Actions of Common Stage Amplifiers Formulas**
- **Multi Stage Transistor Amplifiers Formulas**
- **Transistor Amplifier Characteristics Formulas**

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