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Transistor Amplifier Characteristics Formulas

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List of 18 Transistor Amplifier Characteristics Formulas

Transistor Amplifier Characteristics

1) Amplifier Input of Transistor Amplifier

Open Calculator

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

ex $0.1505\text{V} = 0.301\text{k}\Omega \cdot 0.5\text{mA}$

2) Current Entering Drain Terminal of MOSFET at Saturation

Open Calculator

fx $i_{ds} = \frac{1}{2} \cdot k'_n \cdot \left(\frac{W_c}{L}\right) \cdot (V_{ov})^2$

ex $4.724903\text{mA} = \frac{1}{2} \cdot 0.2\text{A/V}^2 \cdot \left(\frac{10.15\mu\text{m}}{3.25\mu\text{m}}\right) \cdot (0.123\text{V})^2$

3) Current Flowing through Induced Channel in Transistor given Oxide Voltage

Open Calculator

fx $i_o = \left(\mu_e \cdot C_{ox} \cdot \left(\frac{W_c}{L}\right) \cdot (V_{ox} - V_t)\right) \cdot V_{ds}$

ex $14.63474\text{mA} = \left(0.012\text{m}^2\text{/V*s} \cdot 0.001\text{F/m}^2 \cdot \left(\frac{10.15\mu\text{m}}{3.25\mu\text{m}}\right) \cdot (3.775\text{V} - 2\text{V})\right) \cdot 220\text{V}$

4) DC Current Gain of Amplifier

Open Calculator

fx $$A_{dc} = \frac{i_c}{i_b}$$

ex $$2.431252 = \frac{39.52\text{mA}}{16.255\text{mA}}$$

5) Drain Current of Transistor

Open Calculator

fx $$i_d = \frac{V_{fc} + V_d}{R_d}$$

ex $$17.45556\text{mA} = \frac{5\text{V} + 1.284\text{V}}{0.36\text{k}\Omega}$$

6) Input Resistance of Common-Collector Amplifier

Open Calculator

fx $$R_{in} = \frac{V_{fc}}{i_b}$$

ex $$0.307598\text{k}\Omega = \frac{5\text{V}}{16.255\text{mA}}$$

7) Input Resistance of Common-Gate Circuit

Open Calculator

fx $$R_{in} = \frac{V_x}{i_x}$$

ex $$0.303371\text{k}\Omega = \frac{27\text{V}}{89\text{mA}}$$

8) Input Voltage given Signal Voltage

Open Calculator

$$V_{fc} = \left(\frac{R_{fi}}{R_{fi} + R_{sig}} \right) \cdot V_{sig}$$

$$5.066797\text{V} = \left(\frac{2.258\text{k}\Omega}{2.258\text{k}\Omega + 1.12\text{k}\Omega} \right) \cdot 7.58\text{V}$$

9) Input Voltage in Transistor

Open Calculator

$$V_{fc} = R_d \cdot i_d - V_d$$

$$5.016\text{V} = 0.36\text{k}\Omega \cdot 17.5\text{mA} - 1.284\text{V}$$

10) Instantaneous Drain Current using Voltage between Drain and Source

Open Calculator

$$i_d = K_n \cdot (V_{ox} - V_t) \cdot V_{gs}$$

$$17.48907\text{mA} = 2.95\text{mA/V}^2 \cdot (3.775\text{V} - 2\text{V}) \cdot 3.34\text{V}$$

11) Output Resistance of Common Gate Circuit given Test-Voltage

Open Calculator

$$R_{out} = \frac{V_x}{i_x}$$

$$0.303371\text{k}\Omega = \frac{27\text{V}}{89\text{mA}}$$

12) Overall Effective Voltage of MOSFET Transconductance

Open Calculator

$$V_{ov} = \sqrt{2 \cdot \frac{i_{ds}}{k'_n \cdot \left(\frac{W_c}{L} \right)}}$$

$$0.122949\text{V} = \sqrt{2 \cdot \frac{4.721\text{mA}}{0.2\text{A/V}^2 \cdot \left(\frac{10.15\mu\text{m}}{3.25\mu\text{m}} \right)}}$$

13) Signal Current in Emitter given Input Signal

Open Calculator

fx $$i_{se} = \frac{V_{fc}}{R_e}$$

ex $$74.62687\text{mA} = \frac{5\text{V}}{0.067\text{k}\Omega}$$

14) Test Current of Transistor Amplifier

Open Calculator

fx $$i_x = \frac{V_x}{R_{in}}$$

ex $$89.701\text{mA} = \frac{27\text{V}}{0.301\text{k}\Omega}$$

15) Total Instantaneous Drain Voltage

Open Calculator

fx $$V_d = V_{fc} - R_d \cdot i_d$$

ex $$-1.3\text{V} = 5\text{V} - 0.36\text{k}\Omega \cdot 17.5\text{mA}$$

16) Transconductance of Transistor Amplifiers

Open Calculator

fx $$g_{mp} = \frac{2 \cdot i_d}{V_{ox} - V_t}$$

ex $$19.71831\text{mS} = \frac{2 \cdot 17.5\text{mA}}{3.775\text{V} - 2\text{V}}$$

17) Transconductance Parameter of MOS Transistor

Open Calculator

fx $$K_n = \frac{i_d}{(V_{ox} - V_t) \cdot V_{gs}}$$

ex $$2.951843\text{mA/V}^2 = \frac{17.5\text{mA}}{(3.775\text{V} - 2\text{V}) \cdot 3.34\text{V}}$$

18) Transconductance using Collector Current of Transistor Amplifier

Open Calculator

fx $$g_{mp} = \frac{i_c}{V_t}$$

ex $$19.76\text{mS} = \frac{39.52\text{mA}}{2\text{V}}$$

Variables Used

- A_{dc} DC Current Gain
- C_{ox} Oxide Capacitance *(Farad per Square Meter)*
- g_{mp} MOSFET Primary Transconductance *(Millisiemens)*
- i_b Base Current *(Milliampere)*
- i_c Collector Current *(Milliampere)*
- i_d Drain Current *(Milliampere)*
- i_{ds} Saturation Drain Current *(Milliampere)*
- i_{in} Input Current *(Milliampere)*
- i_o Output Current *(Milliampere)*
- i_{se} Signal Current in Emitter *(Milliampere)*
- i_x Test Current *(Milliampere)*
- k'_n Process Transconductance Parameter *(Ampere per Square Volt)*
- K_n Transconductance Parameter *(Milliampere per Square Volt)*
- L Length of Channel *(Micrometer)*
- R_d Drain Resistance *(Kilohm)*
- R_e Emitter Resistance *(Kilohm)*
- R_{fi} Finite Input Resistance *(Kilohm)*
- R_{in} Input Resistance *(Kilohm)*
- R_{out} Finite Output Resistance *(Kilohm)*
- R_{sig} Signal Resistance *(Kilohm)*
- V_d Total Instantaneous Drain Voltage *(Volt)*
- V_{ds} Saturation Voltage between Drain and Source *(Volt)*
- V_{fc} Fundamental Component Voltage *(Volt)*
- V_{gs} Voltage between Gate and Source *(Volt)*

- V_{ip} Amplifier Input *(Volt)*
- V_{ov} Effective Voltage *(Volt)*
- V_{ox} Voltage across Oxide *(Volt)*
- V_{sig} Small Signal Voltage *(Volt)*
- V_t Threshold Voltage *(Volt)*
- V_x Test Voltage *(Volt)*
- W_c Width of Channel *(Micrometer)*
- μ_e Mobility of Electron *(Square Meter per Volt per Second)*

Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Micrometer (µm)
  Length Unit Conversion
- Measurement: **Electric Current** in Milliampere (mA)
  Electric Current Unit Conversion
- Measurement: **Electric Resistance** in Kilohm (kΩ)
  Electric Resistance Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion
- Measurement: **Mobility** in Square Meter per Volt per Second (m²/V*s)
  Mobility Unit Conversion
- Measurement: **Oxide Capacitance Per Unit Area** in Farad per Square Meter (F/m²)
  Oxide Capacitance Per Unit Area Unit Conversion
- Measurement: **Transconductance** in Millisiemens (mS)
  Transconductance Unit Conversion
- Measurement: **Transconductance Parameter** in Ampere per Square Volt (A/V²), Milliampere per Square Volt (mA/V²)
  Transconductance Parameter 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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