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Transistor Operating Parameters Formulas

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List of 13 Transistor Operating Parameters Formulas

Transistor Operating Parameters ⬀

1) Base Current using Current Amplification Factor ⬀

fx $I_b = I_e \cdot (1 - \alpha) - I_{cbo}$

ex $0.4465\text{mA} = 2.75\text{mA} \cdot (1 - 0.714) - 0.34\text{mA}$

2) Base Transport Factor ⬀

fx $\beta = \dfrac{I_c}{I_b}$

ex $2.5 = \dfrac{1.1\text{mA}}{0.44\text{mA}}$

3) Collector Current using Base Transport Factor ⬀

fx $I_c = \beta \cdot I_b$

ex $1.1\text{mA} = 2.5 \cdot 0.44\text{mA}$

4) Collector Current using Current Amplification Factor ⬀

fx $I_c = \alpha \cdot I_e$

ex $1.9635\text{mA} = 0.714 \cdot 2.75\text{mA}$

5) Collector to Emitter Leakage Current 🔗

fx $I_{CEO} = (\beta + 1) \cdot I_{cbo}$

Open Calculator 🔗

ex $1.19mA = (2.5 + 1) \cdot 0.34mA$

6) Collector-Emitter Voltage 🔗

fx $V_{CE} = V_{CC} - I_c \cdot R_c$

Open Calculator 🔗

ex $19.97678V = 20V - 1.1mA \cdot 21.11\Omega$

7) Common Collector Current Gain 🔗

fx $A_i = \beta + 1$

Open Calculator 🔗

ex $3.5 = 2.5 + 1$

8) Current Amplification Factor 🔗

fx $\alpha = \dfrac{I_c}{I_e}$

Open Calculator 🔗

ex $0.4 = \dfrac{1.1mA}{2.75mA}$

9) Current Amplification Factor using Base Transport Factor 🔗

fx $\alpha = \dfrac{\beta}{\beta + 1}$

Open Calculator 🔗

ex $0.714286 = \dfrac{2.5}{2.5 + 1}$

10) Drain Current 🔗

fx $I_D = \mu_n \cdot C_{ox} \cdot \left(\dfrac{W_{gate}}{L_g} \right) \cdot (V_{gs} - V_{th}) \cdot V_{ds}$

Open Calculator 🔗

ex $891\text{mA} = 180\text{m}^2/\text{V}*\text{s} \cdot 75\text{nF} \cdot \left(\dfrac{230\mu\text{m}}{2.3\text{nm}} \right) \cdot (1.25\text{V} - 0.7\text{V}) \cdot 1.2\text{V}$

11) Dynamic Emitter Resistance 🔗

fx $R_e = \dfrac{0.026}{I_e}$

Open Calculator 🔗

ex $9.454545\Omega = \dfrac{0.026}{2.75\text{mA}}$

12) Emitter Current 🔗

fx $I_e = I_b + I_c$

Open Calculator 🔗

ex $1.54\text{mA} = 0.44\text{mA} + 1.1\text{mA}$

13) Emitter Efficiency 🔗

fx $\eta_E = \dfrac{I_{nE}}{I_{nE} + I_h}$

Open Calculator 🔗

ex $0.490196 = \dfrac{25\text{mA}}{25\text{mA} + 26\text{mA}}$

Variables Used

- A_i Common Collector Current Gain
- C_{ox} Gate Oxide Capacitance *(Nanofarad)*
- I_b Base Current *(Milliampere)*
- I_c Collector Current *(Milliampere)*
- I_{cbo} Collector Base Leakage Current *(Milliampere)*
- I_{CEO} Collector Emitter Leakage Current *(Milliampere)*
- I_D Drain Current *(Milliampere)*
- I_e Emitter Current *(Milliampere)*
- I_h Hole Diffusion Current *(Milliampere)*
- I_{nE} Electron Diffusion Current *(Milliampere)*
- L_g Gate Length *(Nanometer)*
- R_c Collector Resistance *(Ohm)*
- R_e Dynamic Emitter Resistance *(Ohm)*
- V_{CC} Common Collector Voltage *(Volt)*
- V_{CE} Collector Emitter Voltage *(Volt)*
- V_{ds} Drain Source Saturation Voltage *(Volt)*
- V_{gs} Gate Source Voltage *(Volt)*
- V_{th} Threshold Voltage *(Volt)*
- W_{gate} Gate Junction Width *(Micrometer)*
- α Current Amplification Factor
- β Base Transport Factor

- η_E Emitter Efficiency

- μ_n Mobility of Electron *(Square Meter per Volt per Second)*

Constants, Functions, Measurements used

- Measurement: **Length** in Micrometer (µm), Nanometer (nm)
  Length Unit Conversion 🔗
- Measurement: **Electric Current** in Milliampere (mA)
  Electric Current Unit Conversion 🔗
- Measurement: **Capacitance** in Nanofarad (nF)
  Capacitance Unit Conversion 🔗
- Measurement: **Electric Resistance** in Ohm (Ω)
  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 🔗

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