Important Transistor Operating Parameters Formulas PDF

Formulas
Examples
with Units

List of 13
Important Transistor Operating Parameters Formulas

1) Base Current using Current Amplification Factor Formula

Evaluate Formula

Formula

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

Example with Units

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

2) Base Transport Factor Formula

Evaluate Formula

Formula

$$\beta = \frac{I_c}{I_b}$$

Example with Units

$$2.5 = \frac{1.1\,\text{mA}}{0.44\,\text{mA}}$$

3) Collector Current using Base Transport Factor Formula

Evaluate Formula

Formula

$$I_c = \beta \cdot I_b$$

Example with Units

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

4) Collector Current using Current Amplification Factor Formula

Evaluate Formula

Formula

$$I_c = \alpha \cdot I_e$$

Example with Units

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

5) Collector to Emitter Leakage Current Formula

Evaluate Formula

Formula

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

Example with Units

$$1.19\,\text{mA} = (2.5 + 1) \cdot 0.34\,\text{mA}$$

6) Collector-Emitter Voltage Formula

Evaluate Formula

Formula

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

Example with Units

$$19.9768\,\text{V} = 20\,\text{V} - 1.1\,\text{mA} \cdot 21.11\,\Omega$$

7) Common Collector Current Gain Formula

Evaluate Formula

Formula

$$A_i = \beta + 1$$

Example

$$3.5 = 2.5 + 1$$

8) Current Amplification Factor Formula

Evaluate Formula

Formula

$$\alpha = \frac{I_c}{I_e}$$

Example with Units

$$0.4 = \frac{1.1\,\text{mA}}{2.75\,\text{mA}}$$

9) Current Amplification Factor using Base Transport Factor Formula

Evaluate Formula

Formula

$$\alpha = \frac{\beta}{\beta + 1}$$

Example

$$0.7143 = \frac{2.5}{2.5 + 1}$$

10) Drain Current Formula

Evaluate Formula

Formula

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

Example with Units

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

11) Dynamic Emitter Resistance Formula

Evaluate Formula

Formula

$$R_e = \frac{0.026}{I_e}$$

Example with Units

$$9.4545\,\Omega = \frac{0.026}{2.75\,\text{mA}}$$

12) Emitter Current Formula

Evaluate Formula

Formula

$$I_e = I_b + I_c$$

Example with Units

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

13) Emitter Efficiency Formula

Evaluate Formula

Formula

$$\eta_E = \frac{I_{nE}}{I_{nE} + I_h}$$

Example with Units

$$0.4902 = \frac{25\,\text{mA}}{25\,\text{mA} + 26\,\text{mA}}$$

Variables used in list of Transistor Operating Parameters Formulas above

- 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 in list of Transistor Operating Parameters Formulas above

- 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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