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BJT Microwave Devices Formulas

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List of 15 BJT Microwave Devices Formulas

BJT Microwave Devices

1) Avalanche Multiplication Factor

Open Calculator

fx $$M = \frac{1}{1 - \left(\frac{V_a}{V_b}\right)^n}$$

ex $$1.074452 = \frac{1}{1 - \left(\frac{20.4V}{22.8V}\right)^{24}}$$

2) Base Collector Delay Time

Open Calculator

fx $$\tau_{scr} = \tau_{ec} - (\tau_c + \tau_b + \tau_e)$$

ex $$5.5\mu s = 5295\mu s - (6.4\mu s + 10.1\mu s + 5273\mu s)$$

3) Base Resistance

Open Calculator

fx $$R_b = \frac{f_{co}}{8 \cdot \pi \cdot f_m^2 \cdot C_c}$$

ex $$0.983203\Omega = \frac{30Hz}{8 \cdot \pi \cdot (69Hz)^2 \cdot 255\mu F}$$

4) Base Transit Time

Open Calculator

fx $\tau_b = \tau_{ec} - (\tau_{scr} + \tau_c + \tau_e)$

ex $10.1\mu s = 5295\mu s - (5.5\mu s + 6.4\mu s + 5273\mu s)$

5) Collector Base Capacitance

Open Calculator

fx $C_c = \frac{f_{co}}{8 \cdot \pi \cdot f_m^2 \cdot R_b}$

ex $255.8333\mu F = \frac{30Hz}{8 \cdot \pi \cdot (69Hz)^2 \cdot 0.98\Omega}$

6) Collector Charging Time

Open Calculator

fx $\tau_c = \tau_{ec} - (\tau_{scr} + \tau_b + \tau_e)$

ex $6.4\mu s = 5295\mu s - (5.5\mu s + 10.1\mu s + 5273\mu s)$

7) Cut-off Frequency of Microwave

Open Calculator

fx $f_{co} = \frac{1}{2 \cdot \pi \cdot \tau_{ec}}$

ex $30.05759Hz = \frac{1}{2 \cdot \pi \cdot 5295\mu s}$

8) Emitter Base Charging Time

Open Calculator

fx $\tau_e = \tau_{ec} - (\tau_{scr} + \tau_c + \tau_b)$

ex $5273\mu s = 5295\mu s - (5.5\mu s + 6.4\mu s + 10.1\mu s)$

9) Emitter to Collector Delay Time

Open Calculator

fx $\tau_{ec} = \tau_{scr} + \tau_c + \tau_b + \tau_e$

ex $5295\mu s = 5.5\mu s + 6.4\mu s + 10.1\mu s + 5273\mu s$

10) Emitter to Collector Distance

Open Calculator

fx $L_{min} = \frac{V_{mb}}{E_{mb}}$

ex $2.19978\mu m = \frac{0.22mV}{100.01V/m}$

11) Hole Current of Emitter

Open Calculator

fx $i_e = i_b + i_c$

ex $8.5A = 4A + 4.5A$

12) Maximum Frequency of Oscillations

Open Calculator

fx $$f_m = \sqrt{\frac{f_T}{8 \cdot \pi \cdot R_b \cdot C_c}}$$

ex $$69.17022\text{Hz} = \sqrt{\frac{30.05\text{Hz}}{8 \cdot \pi \cdot 0.98\Omega \cdot 255\mu\text{F}}}$$

13) Saturation Drift Velocity

Open Calculator

fx $$V_{sc} = \frac{L_{min}}{\Gamma_{avg}}$$

ex $$5\text{m/s} = \frac{2.125\mu\text{m}}{0.425\mu\text{s}}$$

14) Total Charging Time

Open Calculator

fx $$\tau_{ct} = \tau_e + \tau_c$$

ex $$5279.4\mu\text{s} = 5273\mu\text{s} + 6.4\mu\text{s}$$

15) Total Transit Time

Open Calculator

fx $$\tau_{tt} = \tau_b + \tau_{ttc}$$

ex $$19\mu\text{s} = 10.1\mu\text{s} + 8.9\mu\text{s}$$

Variables Used

- C_c Collector Base Capacitance *(Microfarad)*
- E_{mb} Maximum Electric Field in BJT *(Volt per Meter)*
- f_{co} Cut-off Frequency in BJT *(Hertz)*
- f_m Maximum Frequency of Oscillations *(Hertz)*
- f_T Common Emitter Short Circuit Gain Frequency *(Hertz)*
- i_b Base Current *(Ampere)*
- i_c Collector Current *(Ampere)*
- i_e Hole Current of Emitter *(Ampere)*
- L_{min} Emitter to Collector Distance *(Micrometer)*
- M Avalanche Multiplication Factor
- n Doping Numerical Factor
- R_b Base Resistance *(Ohm)*
- V_a Applied Voltage *(Volt)*
- V_b Avalanche Breakdown Voltage *(Volt)*
- V_{mb} Maximum Applied Voltage in BJT *(Millivolt)*
- V_{sc} Saturated Drift Velocity in BJT *(Meter per Second)*
- Γ_{avg} Average Time to Traverse Emitter to Collector *(Microsecond)*
- τ_b Base Transit Time *(Microsecond)*
- τ_c Collector Charging Time *(Microsecond)*
- τ_{ct} Total Charging Time *(Microsecond)*
- τ_e Emitter Charging Time *(Microsecond)*

- T_{ec} Emitter Collector Delay Time *(Microsecond)*
- T_{scr} Base Collector Delay Time *(Microsecond)*
- T_{tt} Total Transit Time *(Microsecond)*
- T_{ttc} Collector Depletion Region *(Microsecond)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Micrometer (µm)
  Length Unit Conversion
- Measurement: **Time** in Microsecond (µs)
  Time Unit Conversion
- Measurement: **Electric Current** in Ampere (A)
  Electric Current Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Capacitance** in Microfarad (µF)
  Capacitance Unit Conversion
- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion
- Measurement: **Electric Field Strength** in Volt per Meter (V/m)
  Electric Field Strength Unit Conversion
- Measurement: **Electric Potential** in Volt (V), Millivolt (mV)
  Electric Potential Unit Conversion

Check other formula lists

- **BJT Microwave Devices Formulas**
- **MESFET Characteristics Formulas**
- **Non Linear Circuits Formulas**
- **Parametric Devices Formulas**

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