

Important BJT Microwave Devices Formulas PDF



Formulas Examples with Units

List of 15 Important BJT Microwave Devices Formulas

1) Avalanche Multiplication Factor Formula ↻

Formula

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

Example with Units

$$1.0745 = \frac{1}{1 - \left(\frac{20.4\text{V}}{22.8\text{V}} \right)^{24}}$$

Evaluate Formula ↻

2) Base Collector Delay Time Formula ↻

Formula

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

Example with Units

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

Evaluate Formula ↻

3) Base Resistance Formula ↻

Formula

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

Example with Units

$$0.9832\Omega = \frac{30\text{Hz}}{8 \cdot 3.1416 \cdot 69\text{Hz}^2 \cdot 255\mu\text{F}}$$

Evaluate Formula ↻

4) Base Transit Time Formula ↻

Formula

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

Example with Units

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

Evaluate Formula ↻

5) Collector Base Capacitance Formula ↻

Formula

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

Example with Units

$$255.8333\mu\text{F} = \frac{30\text{Hz}}{8 \cdot 3.1416 \cdot 69\text{Hz}^2 \cdot 0.98\Omega}$$

Evaluate Formula ↻

6) Collector Charging Time Formula ↻

Formula

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

Example with Units

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

Evaluate Formula ↻



7) Cut-off Frequency of Microwave Formula ↻

Formula

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

Example with Units

$$30.0576 \text{ Hz} = \frac{1}{2 \cdot 3.1416 \cdot 5295 \mu\text{s}}$$

Evaluate Formula ↻

8) Emitter Base Charging Time Formula ↻

Formula

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

Example with Units

$$5273 \mu\text{s} = 5295 \mu\text{s} - (5.5 \mu\text{s} + 6.4 \mu\text{s} + 10.1 \mu\text{s})$$

Evaluate Formula ↻

9) Emitter to Collector Delay Time Formula ↻

Formula

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

Example with Units

$$5295 \mu\text{s} = 5.5 \mu\text{s} + 6.4 \mu\text{s} + 10.1 \mu\text{s} + 5273 \mu\text{s}$$

Evaluate Formula ↻

10) Emitter to Collector Distance Formula ↻

Formula

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

Example with Units

$$2.1998 \mu\text{m} = \frac{0.22 \text{ mV}}{100.01 \text{ V/m}}$$

Evaluate Formula ↻

11) Hole Current of Emitter Formula ↻

Formula

$$i_e = i_b + i_c$$

Example with Units

$$8.5 \text{ A} = 4 \text{ A} + 4.5 \text{ A}$$

Evaluate Formula ↻

12) Maximum Frequency of Oscillations Formula ↻

Formula

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

Example with Units

$$69.1702 \text{ Hz} = \sqrt{\frac{30.05 \text{ Hz}}{8 \cdot 3.1416 \cdot 0.98 \Omega \cdot 255 \mu\text{F}}}$$

Evaluate Formula ↻

13) Saturation Drift Velocity Formula ↻

Formula

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

Example with Units

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

Evaluate Formula ↻

14) Total Charging Time Formula ↻

Formula

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

Example with Units

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

Evaluate Formula ↻



15) Total Transit Time Formula

Formula

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

Example with Units

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

Evaluate Formula 



Variables used in list of BJT Microwave Devices Formulas above

- **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)
- **T_b** Base Transit Time (Microsecond)
- **T_c** Collector Charging Time (Microsecond)
- **T_{ct}** Total Charging Time (Microsecond)
- **T_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 in list of BJT Microwave Devices Formulas above

- **constant(s):** pi, 3.14159265358979323846264338327950288 Archimedes' constant
- **Functions:** 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 



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