

Important Basic Transistor Devices Formulas PDF



Formulas Examples with Units

List of 16 Important Basic Transistor Devices Formulas

1) BJT Formulas

1.1) BJT Turn OFF Time Formula

Formula

$$T_{\text{off}} = T_s + T_f$$

Example with Units

$$3.399_s = 1.549_s + 1.85_s$$

Evaluate Formula

1.2) BJT Turn ON Time Formula

Formula

$$T_{\text{on}} = T_r + T_d$$

Example with Units

$$2.9_s = 1.75_s + 1.15_s$$

Evaluate Formula

1.3) Power Loss in BJT Formula

Formula

$$P_{\text{loss}} = E_{\text{loss}} \cdot f_{\text{sw}}$$

Example with Units

$$187.5_W = 0.125_J \cdot 1.5_{\text{kHz}}$$

Evaluate Formula

1.4) Reverse Recovery Charge Formula

Formula

$$Q_{\text{RR}} = 0.5 \cdot I_{\text{RR}} \cdot t_{\text{rr}}$$

Example with Units

$$0.0401_C = 0.5 \cdot 35_{\text{mA}} \cdot 2.29_s$$

Evaluate Formula

1.5) Reverse Recovery Current Formula

Formula

$$I_{\text{RR}} = \sqrt{2 \cdot Q_{\text{RR}} \cdot \Delta I}$$

Example with Units

$$35.0086_{\text{mA}} = \sqrt{2 \cdot 0.04_C \cdot 15.32_{\text{mA}}}$$

Evaluate Formula

1.6) Reverse Recovery Time Formula

Formula

$$t_{\text{rr}} = \sqrt{2 \cdot \frac{Q_{\text{RR}}}{\Delta I}}$$

Example with Units

$$2.2852_s = \sqrt{2 \cdot \frac{0.04_C}{15.32_{\text{mA}}}}$$

Evaluate Formula



1.7) Softness Factor Formula

Formula

$$s = \frac{t_b}{t_a}$$

Example with Units

$$0.2351 = \frac{2.25 \text{ s}}{9.57 \text{ s}}$$

Evaluate Formula 

2) MOSFET Formulas

2.1) Current Ripple Factor Formula

Formula

$$\text{CRF} = \left(\left(\frac{I_{\text{rms}}}{I_o} \right) - 1 \right)^{0.5}$$

Example with Units

$$0.8944 = \left(\left(\frac{90 \text{ mA}}{50 \text{ mA}} \right) - 1 \right)^{0.5}$$

Evaluate Formula 

2.2) Input Current Distortion Factor Formula

Formula

$$\text{CDF} = \frac{I_{s1}}{I_s}$$

Example with Units

$$0.5 = \frac{8 \text{ mA}}{16 \text{ mA}}$$

Evaluate Formula 

2.3) Input Current Harmonic Factor Formula

Formula

$$\text{CHF} = \sqrt{\left(\frac{1}{\text{CDF}^2} \right) - 1}$$

Example

$$1.7321 = \sqrt{\left(\frac{1}{0.5^2} \right) - 1}$$

Evaluate Formula 

2.4) MOSFET Turn Off Time Formula

Formula

$$T_{\text{off}} = T_{\text{d-off}} + T_f$$

Example with Units

$$3.4 \text{ s} = 1.55 \text{ s} + 1.85 \text{ s}$$

Evaluate Formula 

2.5) MOSFET Turn ON Time Formula

Formula

$$T_{\text{on}} = T_{\text{d-on}} + T_r$$

Example with Units

$$2.899 \text{ s} = 1.149 \text{ s} + 1.75 \text{ s}$$

Evaluate Formula 

2.6) Power Loss in MOSFET Formula

Formula

$$P_{\text{loss}} = I_d^2 \cdot R_{\text{ds}}$$

Example with Units

$$187.425 \text{ W} = 105 \text{ mA}^2 \cdot 17 \text{ k}\Omega$$

Evaluate Formula 



2.7) Rectification Ratio Formula

Formula

$$\eta = \frac{P_{DC}}{P_{AC}}$$

Example with Units

$$0.625 = \frac{25\text{ w}}{40\text{ w}}$$

Evaluate Formula 

2.8) Transistor Aspect Ratio Formula

Formula

$$WL = \frac{b_{ch}}{L_{ch}}$$

Example with Units

$$4.7442 = \frac{10.2\text{ }\mu\text{m}}{2.15\text{ }\mu\text{m}}$$

Evaluate Formula 

2.9) Voltage Ripple Factor Formula

Formula

$$VRF = \frac{V_r}{V_{DC}}$$

Example with Units

$$0.3333 = \frac{5\text{ v}}{15\text{ v}}$$

Evaluate Formula 



Variables used in list of Basic Transistor Devices Formulas above

- b_{ch} Width of Channel (Micrometer)
- **CDF** Input Current Distortion Factor
- **CHF** Input Current Harmonic Factor
- **CRF** Current Ripple Factor
- E_{loss} Energy Loss (Joule)
- f_{sw} Switching Frequency (Kilohertz)
- I_d Drain Current (Milliampere)
- I_o RMS Current DC Component (Milliampere)
- I_{rms} RMS Current (Milliampere)
- I_{RR} Reverse Recovery Current (Milliampere)
- I_s RMS Supply Current (Milliampere)
- I_{s1} RMS Supply Current Fundamental Component (Milliampere)
- L_{ch} Channel Length (Micrometer)
- P_{AC} AC Input Power (Watt)
- P_{DC} DC Power Output (Watt)
- P_{loss} Average Power Loss (Watt)
- Q_{RR} Reverse Recovery Charge (Coulomb)
- R_{ds} Drain Source Resistance (Kilohm)
- s Softness Factor
- t_a Forward Current Decay Time (Second)
- t_b Reverse Current Decay Time (Second)
- T_d Delay Time (Second)
- T_{d-off} MOSFET OFF Delay Time (Second)
- T_{d-on} MOSFET ON Delay Time (Second)
- T_f Fall Time (Second)
- T_{off} Turn OFF Time (Second)
- T_{on} Turn ON Time (Second)
- T_r Rise Time (Second)
- t_{rr} Reverse Recovery Time (Second)
- T_s Storage Time (Second)

Constants, Functions, Measurements used in list of Basic Transistor Devices Formulas above

- **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 Second (s)
Time Unit Conversion 
- **Measurement:** **Electric Current** in Milliampere (mA)
Electric Current Unit Conversion 
- **Measurement:** **Energy** in Joule (J)
Energy Unit Conversion 
- **Measurement:** **Electric Charge** in Coulomb (C)
Electric Charge Unit Conversion 
- **Measurement:** **Power** in Watt (W)
Power Unit Conversion 
- **Measurement:** **Frequency** in Kilohertz (kHz)
Frequency Unit Conversion 
- **Measurement:** **Electric Resistance** in Kilohm ($k\Omega$)
Electric Resistance Unit Conversion 
- **Measurement:** **Electric Potential** in Volt (V)
Electric Potential Unit Conversion 



- **V_{DC}** DC Output Voltage (*Volt*)
- **V_r** Ripple Voltage (*Volt*)
- **VRF** Voltage Ripple Factor
- **WL** Aspect Ratio
- **ΔI** Change in Current (*Milliampere*)
- **η** Rectification Ratio



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