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Non Linear Circuits Formulas

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List of 16 Non Linear Circuits Formulas

Non Linear Circuits

1) Amplifier Gain of Tunnel Diode

Open Calculator

fx $$A_v = \frac{R_n}{R_n - R_L}$$

ex $$1.062069\text{dB} = \frac{77\Omega}{77\Omega - 4.5\Omega}$$

2) Average Diode Temperature using Single Side Band Noise

Open Calculator

fx $$T_d = (F_{ssb} - 2) \cdot \left(\frac{R_g \cdot T_0}{2 \cdot R_d} \right)$$

ex $$289.9286\text{K} = (14.3\text{dB} - 2) \cdot \left(\frac{33\Omega \cdot 300\text{K}}{2 \cdot 210\Omega} \right)$$

3) Bandwidth using Dynamic Quality Factor

Open Calculator

fx $$S = \frac{Q_d}{\omega \cdot R_s}$$

ex $$0.003794\text{Hz} = \frac{0.012}{5.75\text{rad/s} \cdot 0.55\Omega}$$

4) Dynamic Q Factor

Open Calculator

fx $$Q_d = \frac{S}{\omega \cdot R_s}$$

ex $$0.012648 = \frac{0.04\text{Hz}}{5.75\text{rad/s} \cdot 0.55\Omega}$$

5) Magnitude of Negative Resistance

Open Calculator

fx $$R_n = \frac{1}{g_m}$$

ex $$76.92308\Omega = \frac{1}{0.013\text{S}}$$

6) Maximum Applied Current across Diode

Open Calculator

fx $$I_m = \frac{V_m}{X_c}$$

ex $$0.014\text{A} = \frac{77\text{mV}}{5.5\text{H}}$$

7) Maximum Applied Voltage across Diode

Open Calculator

fx $$V_m = E_m \cdot L_{depl}$$

ex $$77\text{mV} = 100\text{V/m} \cdot 0.77\text{mm}$$

8) Negative Conductance of Tunnel Diode

Open Calculator

fx $$g_m = \frac{1}{R_n}$$

ex $$0.012987\text{S} = \frac{1}{77\Omega}$$

9) Noise Figure of Double Side Band

Open Calculator

fx $$F_{dsb} = 1 + \left(\frac{T_d \cdot R_d}{R_g \cdot T_0}\right)$$

ex $$7.151515\text{dB} = 1 + \left(\frac{290\text{K} \cdot 210\Omega}{33\Omega \cdot 300\text{K}}\right)$$

10) Noise Figure of Single Side Band

Open Calculator

fx $$F_{ssb} = 2 + \left(\frac{2 \cdot T_d \cdot R_d}{R_g \cdot T_0}\right)$$

ex $$14.30303\text{dB} = 2 + \left(\frac{2 \cdot 290\text{K} \cdot 210\Omega}{33\Omega \cdot 300\text{K}}\right)$$

11) Power Gain of Tunnel Diode

Open Calculator

fx $$\text{gain} = \Gamma^2$$

ex $$0.0169\text{dB} = (0.13)^2$$

12) Ratio Negative Resistance to Series Resistance

Open Calculator

$$\alpha = \frac{R_{eq}}{R_{Ti}}$$

$$9 = \frac{90\Omega}{10\Omega}$$

13) Reactive Impedence

Open Calculator

$$X_c = \frac{V_m}{I_m}$$

$$5.5H = \frac{77mV}{0.014A}$$

14) Room Temperature

Open Calculator

$$T_0 = \frac{2 \cdot T_d \cdot \left(\left(\frac{1}{\gamma \cdot Q}\right) + \left(\frac{1}{(\gamma \cdot Q)^2}\right)\right)}{F - 1}$$

$$300.2532K = \frac{2 \cdot 290K \cdot \left(\left(\frac{1}{0.19 \cdot 12.72}\right) + \left(\frac{1}{(0.19 \cdot 12.72)^2}\right)\right)}{2.13dB - 1}$$

15) Tunnel Diode Output Power

Open Calculator

$$P_o = \frac{V_{dc} \cdot I_{dc}}{2 \cdot \pi}$$

$$30.63733W = \frac{35V \cdot 5.5A}{2 \cdot \pi}$$

16) Voltage Reflection Coefficient of Tunnel Diode

Open Calculator

fx $$\Gamma = \frac{Z_d - Z_o}{Z_d + Z_o}$$

ex $$0.130435 = \frac{65\Omega - 50\Omega}{65\Omega + 50\Omega}$$

Variables Used

- A_v Amplifier Gain of Tunnel Diode *(Decibel)*
- E_m Maximum Electric Field *(Volt per Meter)*
- F Noise Figure of Up-Converter *(Decibel)*
- F_{dsb} Noise Figure of Double Side Band *(Decibel)*
- F_{ssb} Noise Figure of Single Side Band *(Decibel)*
- g_m Negative Conductance Tunnel Diode *(Siemens)*
- $gain$ Power Gain of Tunnel Diode *(Decibel)*
- I_{dc} Current Tunnel Diode *(Ampere)*
- I_m Maximum Applied Current *(Ampere)*
- L_{depl} Depletion Length *(Millimeter)*
- P_o Output Power of Tunnel Diode *(Watt)*
- Q Q Factor
- Q_d Dynamic Q-Factor
- R_d Diode Resistance *(Ohm)*
- R_{eq} Equivalent Negative Resistance *(Ohm)*
- R_g Output Resistance of Signal Generator *(Ohm)*
- R_L Load Resistance *(Ohm)*
- R_n Negative Resistance in Tunnel Diode *(Ohm)*
- R_s Series Resistance of Diode *(Ohm)*
- R_{Ti} Total Series Resistance at Idler Frequency *(Ohm)*
- S Bandwidth *(Hertz)*

- T_0 Ambient Temperature *(Kelvin)*
- T_d Diode Temperature *(Kelvin)*
- V_{dc} Voltage Tunnel Diode *(Volt)*
- V_m Maximum Applied Voltage *(Millivolt)*
- X_c Reactive Impedence *(Henry)*
- Z_d Impedance Tunnel Diode *(Ohm)*
- Z_o Characteristic Impedance *(Ohm)*
- α Ratio Negative Resistance to Series Resistance
- γ Coupling Coefficient
- Γ Voltage Reflection Coefficient
- ω Angular Frequency *(Radian per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Electric Current** in Ampere (A)
  Electric Current Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Noise** in Decibel (dB)
  Noise Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion
- Measurement: **Electric Conductance** in Siemens (S)
  Electric Conductance Unit Conversion
- Measurement: **Inductance** in Henry (H)
  Inductance Unit Conversion
- Measurement: **Electric Field Strength** in Volt per Meter (V/m)
  Electric Field Strength Unit Conversion
- Measurement: **Electric Potential** in Millivolt (mV), Volt (V)
  Electric Potential Unit Conversion
- Measurement: **Sound** in Decibel (dB)
  Sound Unit Conversion

- Measurement: **Angular Frequency** in Radian per Second (rad/s)
  Angular Frequency Unit Conversion

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

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