Important Non Linear Circuits Formulas PDF

Formulas
Examples
with Units

List of 16
Important Non Linear Circuits Formulas

1) Amplifier Gain of Tunnel Diode Formula

Evaluate Formula

Formula

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

Example with Units

$$1.0621\,\text{dB} = \frac{77\,\Omega}{77\,\Omega - 4.5\,\Omega}$$

2) Average Diode Temperature using Single Side Band Noise Formula

Evaluate Formula

Formula

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

Example with Units

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

3) Bandwidth using Dynamic Quality Factor Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0038\,\text{Hz} = \frac{0.012}{5.75\,\text{rad/s} \cdot 0.55\,\Omega}$$

4) Dynamic Q Factor Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0126 = \frac{0.04\,\text{Hz}}{5.75\,\text{rad/s} \cdot 0.55\,\Omega}$$

5) Magnitude of Negative Resistance Formula

Evaluate Formula

Formula

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

Example with Units

$$76.9231\,\Omega = \frac{1}{0.013\,\text{S}}$$

6) Maximum Applied Current across Diode Formula

Evaluate Formula

Formula

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

Example with Units

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

7) Maximum Applied Voltage across Diode Formula

Evaluate Formula

Formula

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

Example with Units

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

8) Negative Conductance of Tunnel Diode Formula

Evaluate Formula

Formula

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

Example with Units

$$0.013\,\text{S} = \frac{1}{77\,\Omega}$$

9) Noise Figure of Double Side Band Formula

Evaluate Formula

Formula

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

Example with Units

$$7.1515\,\text{dB} = 1 + \left(\frac{290\,\text{K} \cdot 210\,\Omega}{33\,\Omega \cdot 300\,\text{K}}\right)$$

10) Noise Figure of Single Side Band Formula

Evaluate Formula

Formula

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

Example with Units

$$14.303\,\text{dB} = 2 + \left(\frac{2 \cdot 290\,\text{K} \cdot 210\,\Omega}{33\,\Omega \cdot 300\,\text{K}}\right)$$

11) Power Gain of Tunnel Diode Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0169\,\text{dB} = 0.13^2$$

12) Ratio Negative Resistance to Series Resistance Formula

Evaluate Formula

Formula

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

Example with Units

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

13) Reactive Impedence Formula

Evaluate Formula

Formula

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

Example with Units

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

14) Room Temperature Formula

Evaluate Formula

Formula

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

Example with Units

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

15) Tunnel Diode Output Power Formula

Evaluate Formula

Formula

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

Example with Units

$$30.6373\,\text{W} = \frac{35\,\text{V} \cdot 5.5\,\text{A}}{2 \cdot 3.1416}$$

16) Voltage Reflection Coefficient of Tunnel Diode Formula

Evaluate Formula

Formula

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

Example with Units

$$0.1304 = \frac{65\,\Omega - 50\,\Omega}{65\,\Omega + 50\,\Omega}$$

Variables used in list of Non Linear Circuits Formulas above

- 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

Constants, Functions, Measurements used in list of Non Linear Circuits Formulas above

- constant(s): **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

- **Γ** Voltage Reflection Coefficient
- **ω** Angular Frequency *(Radian per Second)*

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