

Important Parametric Devices Formulas PDF



Formulas Examples with Units

List of 13 Important Parametric Devices Formulas

1) Bandwidth of Negative Resistance Parametric Amplifier (NRPA) Formula

Formula

$$BW_{NRPA} = \left(\frac{\gamma}{2} \right) \cdot \sqrt{\frac{f_i}{f_s \cdot G_{NRPA}}}$$

Example with Units

$$0.0276 \text{ Hz} = \left(\frac{0.19}{2} \right) \cdot \sqrt{\frac{125 \text{ Hz}}{95 \text{ Hz} \cdot 15.6 \text{ dB}}}$$

Evaluate Formula

2) Bandwidth of Parametric Up-Converter Formula

Formula

$$BW_{up} = 2 \cdot \gamma \cdot \sqrt{\frac{f_o}{f_s}}$$

Example with Units

$$1.2017 \text{ Hz} = 2 \cdot 0.19 \cdot \sqrt{\frac{950 \text{ Hz}}{95 \text{ Hz}}}$$

Evaluate Formula

3) Gain-Degradation Factor Formula

Formula

$$GDF = \left(\frac{f_s}{f_o} \right) \cdot G_{up}$$

Example with Units

$$0.8 = \left(\frac{95 \text{ Hz}}{950 \text{ Hz}} \right) \cdot 8 \text{ dB}$$

Evaluate Formula

4) Idler Frequency using Pumping Frequency Formula

Formula

$$f_i = f_p - f_s$$

Example with Units

$$125 \text{ Hz} = 220 \text{ Hz} - 95 \text{ Hz}$$

Evaluate Formula

5) Noise Figure of Parametric Up-Converter Formula

Formula

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

Example with Units

$$2.9449 \text{ dB} = 1 + \left(\frac{2 \cdot 290 \text{ K}}{0.19 \cdot 5.25 \cdot 300 \text{ K}} + \frac{2}{300 \text{ K} \cdot (0.19 \cdot 5.25)^2} \right)$$

Evaluate Formula



6) Output Frequency in Up-Converter Formula ↻

Formula

$$f_o = \left(\frac{G_{up}}{GDF} \right) \cdot f_s$$

Example with Units

$$950 \text{ Hz} = \left(\frac{8 \text{ dB}}{0.8} \right) \cdot 95 \text{ Hz}$$

Evaluate Formula ↻

7) Output Resistance of Signal Generator Formula ↻

Formula

$$R_g = \frac{G_{NRPA} \cdot f_s \cdot R_{TS} \cdot R_{Ti} \cdot (1 - \alpha)^2}{4 \cdot f_s \cdot R_i \cdot \alpha}$$

Example with Units

$$33.28 \Omega = \frac{15.6 \text{ dB} \cdot 95 \text{ Hz} \cdot 7.8 \Omega \cdot 10 \Omega \cdot (1 - 9)^2}{4 \cdot 95 \text{ Hz} \cdot 65 \Omega \cdot 9}$$

Evaluate Formula ↻

8) Power Gain for Parametric Up-Converter Formula ↻

Formula

$$G_{up} = \left(\frac{f_o}{f_s} \right) \cdot GDF$$

Example with Units

$$8 \text{ dB} = \left(\frac{950 \text{ Hz}}{95 \text{ Hz}} \right) \cdot 0.8$$

Evaluate Formula ↻

9) Power Gain of Demodulator Formula ↻

Formula

$$G_{dm} = \frac{f_s}{f_p + f_s}$$

Example with Units

$$0.3016 \text{ dB} = \frac{95 \text{ Hz}}{220 \text{ Hz} + 95 \text{ Hz}}$$

Evaluate Formula ↻

10) Power Gain of Down-Converter Formula ↻

Formula

$$G_{down} = \frac{4 \cdot f_i \cdot R_i \cdot R_g \cdot \alpha}{f_s \cdot R_{TS} \cdot R_{Ti} \cdot (1 - \alpha)^2}$$

Example with Units

$$20.3536 \text{ dB} = \frac{4 \cdot 125 \text{ Hz} \cdot 65 \Omega \cdot 33 \Omega \cdot 9}{95 \text{ Hz} \cdot 7.8 \Omega \cdot 10 \Omega \cdot (1 - 9)^2}$$

Evaluate Formula ↻

11) Power Gain of Modulator Formula ↻

Formula

$$G_m = \frac{f_p + f_s}{f_s}$$

Example with Units

$$3.3158 \text{ dB} = \frac{220 \text{ Hz} + 95 \text{ Hz}}{95 \text{ Hz}}$$

Evaluate Formula ↻



12) Pumping Frequency using Demodulator Gain Formula

Formula

$$f_p = \left(\frac{f_s}{G_{dm}} \right) - f_s$$

Example with Units

$$221.6667 \text{ Hz} = \left(\frac{95 \text{ Hz}}{0.3 \text{ dB}} \right) - 95 \text{ Hz}$$

Evaluate Formula 

13) Signal frequency Formula

Formula

$$f_s = \frac{f_p}{G_m - 1}$$

Example with Units

$$95.0324 \text{ Hz} = \frac{220 \text{ Hz}}{3.315 \text{ dB} - 1}$$






Evaluate Formula 



Variables used in list of Parametric Devices Formulas above





- **BW_{NRPA}** Bandwidth of NRPA (Hertz)
- **BW_{up}** Bandwidth of Up-Converter (Hertz)
- **F** Noise Figure of Up-Converter (Decibel)
- **f_i** Idler Frequency (Hertz)
- **f_o** Output Frequency (Hertz)
- **f_p** Pumping Frequency (Hertz)
- **f_s** Signal Frequency (Hertz)
- **G_{dm}** Power Gain of Demodulator (Decibel)
- **G_{down}** Power Gain Down-Converter (Decibel)
- **G_m** Power Gain of Modulator (Decibel)
- **G_{NRPA}** Gain of NRPA (Decibel)
- **G_{up}** Power Gain for Up-Converter (Decibel)
- **GDF** Gain Degradation Factor
- **Q_{up}** Q-Factor of Up-Converter
- **R_g** Output Resistance of Signal Generator (Ohm)
- **R_i** Output Resistance of Idler Generator (Ohm)
- **R_{Ti}** Total Series Resistance at Idler Frequency (Ohm)
- **R_{Ts}** Total Series Resistance at Signal Frequency (Ohm)
- **T₀** Ambient Temperature (Kelvin)
- **T_d** Diode Temperature (Kelvin)
- **α** Ratio Negative Resistance to Series Resistance
- **γ** Coupling Coefficient

Constants, Functions, Measurements used in list of Parametric 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: Temperature** in Kelvin (K)
Temperature 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: Sound** in Decibel (dB)
Sound Unit Conversion 



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