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Magnetron Oscillator Formulas

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List of 17 Magnetron Oscillator Formulas

Magnetron Oscillator

1) Anode Current

Open Calculator

fx $$I_0 = \frac{P_{gen}}{V_0 \cdot \eta_e}$$

ex $$2.125095\text{A} = \frac{33.704\text{kW}}{26000\text{V} \cdot 0.61}$$

2) Characteristic Admittance

Open Calculator

fx $$Y = \frac{1}{Z_o}$$

ex $$0.473934\text{S} = \frac{1}{2.11\Omega}$$

3) Circuit Efficiency in Magnetron

Open Calculator

fx $$\eta = \frac{G_r}{G_r + G}$$

ex $$0.934579 = \frac{2\text{e-}4\text{S}}{2\text{e-}4\text{S} + 1.4\text{e-}5\text{S}}$$

4) Cyclotron Angular Frequency

Open Calculator

fx $$\omega_c = B_Z \cdot \left(\frac{[\text{Charge-e}]}{[\text{Mass-e}]} \right)$$

ex $$7914.69\text{rad/s} = 4.5\text{e-}8\text{Wb/m}^2 \cdot \left(\frac{[\text{Charge-e}]}{[\text{Mass-e}]} \right)$$

5) Distance between Anode and Cathode

Open Calculator

fx $$d = \left(\frac{1}{B_{0c}} \right) \cdot \sqrt{2 \cdot \left(\frac{[\text{Mass-e}]}{[\text{Charge-e}]} \right) \cdot V_0}$$

ex $$0.060416\text{m} = \left(\frac{1}{0.009\text{Wb/m}^2} \right) \cdot \sqrt{2 \cdot \left(\frac{[\text{Mass-e}]}{[\text{Charge-e}]} \right) \cdot 26000\text{V}}$$

6) Electron Uniform Velocity

Open Calculator

fx $$E_{vo} = \sqrt{(2 \cdot V_o) \cdot \left(\frac{[\text{Charge-e}]}{[\text{Mass-e}]} \right)}$$

ex $$258525\text{m/s} = \sqrt{(2 \cdot 0.19\text{V}) \cdot \left(\frac{[\text{Charge-e}]}{[\text{Mass-e}]} \right)}$$

7) Electronic Efficiency

Open Calculator

fx $$\eta_e = \frac{P_{gen}}{P_{dc}}$$

ex $$0.6128 = \frac{33.704\text{kW}}{55\text{kW}}$$

8) Hull Cutoff Magnetic Flux Density

Open Calculator

fx $$B_{0c} = \left(\frac{1}{d}\right) \cdot \sqrt{2 \cdot \left(\frac{[\text{Mass-e}]}{[\text{Charge-e}]}\right) \cdot V_0}$$

ex $$0.009062\text{Wb/m}^2 = \left(\frac{1}{0.06\text{m}}\right) \cdot \sqrt{2 \cdot \left(\frac{[\text{Mass-e}]}{[\text{Charge-e}]}\right) \cdot 26000\text{V}}$$

9) Hull Cut-off Voltage

Open Calculator

fx $$V_c = \left(\frac{1}{2}\right) \cdot \left(\frac{[\text{Charge-e}]}{[\text{Mass-e}]}\right) \cdot B_{0c}^2 \cdot d^2$$

ex $$25643.6\text{V} = \left(\frac{1}{2}\right) \cdot \left(\frac{[\text{Charge-e}]}{[\text{Mass-e}]}\right) \cdot (0.009\text{Wb/m}^2)^2 \cdot (0.06\text{m})^2$$

10) Magnetron Phase Shift

Open Calculator

fx $$\Phi_n = 2 \cdot \pi \cdot \left(\frac{M}{N} \right)$$

ex $$90^\circ = 2 \cdot \pi \cdot \left(\frac{4}{16} \right)$$

11) Modulation Linearity

Open Calculator

fx $$m = \frac{\Delta f_m}{f_m}$$

ex $$0.166667 = \frac{7.5\text{Hz}}{45\text{Hz}}$$

12) Noise Ratio

Open Calculator

fx $$SNR = \left(\frac{SNR_{in}}{SNR_{out}} \right) - 1$$

ex $$0.358929 = \left(\frac{0.761}{0.56} \right) - 1$$

13) Receiver Sensitivity

Open Calculator

fx $$S_r = RNF + SNR$$

ex $$6.458\text{dB} = 6.1\text{dB} + 0.358$$

14) Repetition Frequency of Pulse

Open Calculator

fx $$f_r = \frac{f_{sl} - f_c}{N_s}$$

ex $$1.43\text{Hz} = \frac{10.25\text{Hz} - 3.1\text{Hz}}{5}$$

15) RF Pulse Width

Open Calculator

fx $$T_{eff} = \frac{1}{2 \cdot BW}$$

ex $$0.008929\text{s} = \frac{1}{2 \cdot 56\text{Hz}}$$

16) Space Charge Reduction Factor

Open Calculator

fx $$R = \frac{\omega_q}{f_p}$$

ex $$0.857143 = \frac{1.2\text{e}6\text{rad/s}}{1.4\text{e}6\text{rad/s}}$$

17) Spectral Line Frequency

Open Calculator

fx $$f_{sl} = f_c + N_s \cdot f_r$$

ex $$10.25\text{Hz} = 3.1\text{Hz} + 5 \cdot 1.43\text{Hz}$$

Variables Used

- B_{0c} Hull Cutoff Magnetic Flux Density *(Weber per Square Meter)*
- B_Z Magnetic Flux Density in Z Direction *(Weber per Square Meter)*
- **BW** Bandwidth *(Hertz)*
- **d** Distance Between Anode and Cathode *(Meter)*
- E_{vo} Electron Uniform Velocity *(Meter per Second)*
- f_c Carrier Frequency *(Hertz)*
- f_m Peak Frequency *(Hertz)*
- f_p Plasma Frequency *(Radian per Second)*
- f_r Repetition Frequency *(Hertz)*
- f_{sl} Spectral Line Frequency *(Hertz)*
- **G** Conductance of Cavity *(Siemens)*
- G_r Resonator Conductance *(Siemens)*
- I_0 Anode Current *(Ampere)*
- **m** Modulation Linearity
- **M** Number of Oscillation
- **N** Number of Resonant Cavities
- N_s Number of Samples
- P_{dc} DC Power Supply *(Kilowatt)*
- P_{gen} Power Generated in Anode Circuit *(Kilowatt)*
- **R** Space Charge Reduction Factor
- **RNF** Receiver Noise Floor *(Decibel)*
- S_r Receiver Sensitivity *(Decibel)*

- **SNR** Signal Noise Ratio
- $\mathbf{SNR_{in}}$ Input Signal Noise Ratio
- $\mathbf{SNR_{out}}$ Output Signal Noise Ratio
- $\mathbf{T_{eff}}$ RF Pulse Width *(Second)*
- $\mathbf{V_0}$ Anode Voltage *(Volt)*
- $\mathbf{V_c}$ Hull Cut off Voltage *(Volt)*
- $\mathbf{V_o}$ Beam Voltage *(Volt)*
- **Y** Characteristic Admittance *(Siemens)*
- $\mathbf{Z_o}$ Characteristic Impedance *(Ohm)*
- $\mathbf{\Delta f_m}$ Maximum Frequency Deviation *(Hertz)*
- $\mathbf{\eta}$ Circuit Efficiency
- $\mathbf{\eta_e}$ Electronic Efficiency
- $\mathbf{\Phi_n}$ Phase Shift in Magnetron *(Degree)*
- $\mathbf{\omega_c}$ Cyclotron Angular Frequency *(Radian per Second)*
- $\mathbf{\omega_q}$ Reduced Plasma Frequency *(Radian per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[Charge-e]**, 1.60217662E-19 Coulomb
  Charge of electron
- Constant: **[Mass-e]**, 9.10938356E-31 Kilogram
  Mass of electron
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  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: **Power** in Kilowatt (kW)
  Power Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle 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: **Magnetic Flux Density** in Weber per Square Meter (Wb/m²)
  Magnetic Flux Density Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion
- Measurement: **Angular Frequency** in Radian per Second (rad/s)
  Angular Frequency Unit Conversion

Check other formula lists

- Beam Tube Formulas
- Helix Tube Formulas
- Klystron Formulas
- Klystron Cavity Formulas
- Magnetron Oscillator Formulas
- Q-Factor Formulas

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