

Performance Characteristics of Klystron

- Frequency 250Mhz-100 GHz
- Power -10kW -500 kW
- Power gain 15 db-70 db
- Bandwidth – limited 10-60 MHz (fixed) application
- Noise figure -15-20 db
- Efficiency -58%

Application

1) As power o/p tubes

- In UHF TV transmitter
- Satellite Communication Ground station
- Radar transmitter

2) As power oscillator (5-50 Ghz) is used as Klystron amplifier

Mathematical analysis

$$v_0 = \sqrt{\frac{2eV_0}{m}} = 0.593 * 10^6 \sqrt{v_0} m/s$$

$$V_s = V_1 \sin \omega t_1$$

$$\frac{1}{2} m v_1^2 = e(V_0 + V_1 \sin \omega t_1)$$

$$v_1 = \sqrt{\frac{2e(V_0 + V_1 \sin \omega t_1)}{m}}$$

$$v_1 = v_0 \left(1 + \frac{V_1}{V_0} \sin \omega t_1 \right)^{1/2}$$

$$v_1 = v_0 \left(1 + \frac{V_1}{2V_0} \sin \omega t_1 \right)$$

$$\omega t_1 = \omega t_0 + \frac{\theta_g}{2}$$

θ_g is the phase angle of RF input voltage

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$$\theta_g = \omega t = \omega(t_1 - t_0) = \frac{\omega d}{v_0}$$

Bunching process of Electron Beam

$$v_{1(\max)} = v_0 \left(1 + \frac{V_1}{2V_0} \right) \text{ at } \pi/2$$

$$v_{1(\min)} = v_0 \left(1 - \frac{V_1}{2V_0} \right) \text{ at } -\pi/2$$

$$L_1 = v_0 (t_1 - t_0)$$

Bunching process of Electron Beam

$$t_{-\pi/2} = v_{\min} (t_1 - t_{-\pi/2})$$

$$t_{\pi/2} = v_{\max} (t_1 - t_{+\pi/2})$$

$$t_{-\pi/2} = (t_0 - \pi / 2\omega)$$

$$t_{\pi/2} = (t_0 + \pi / 2\omega)$$

$$L_1 \text{ at } t_{-\lambda/2} = v_0 \left(1 + \frac{V_1}{2V_0} \right) (t_1 - t_0 + \pi / 2\omega)$$

$$L_1 \text{ at } t_{+\lambda/2} = v_0 \left(1 + \frac{V_1}{2V_0} \right) (t_1 - t_0 - \pi / 2\omega)$$

$$\therefore L_1 = v_0(t_1 - t_0) + v_0 \left[\frac{\pi}{2\omega} - \frac{V_1}{2V_{01}}(t_1 - t_0) - \frac{V_1}{2V_0} \pi / 2\omega \right]$$

$$\left[\frac{\pi}{2\omega} - \frac{V_1}{2V_{01}}(t_1 - t_0) - \frac{V_1}{2V_0} \pi / 2\omega \right] = 0$$

$$-(t_1 - t_0) = \frac{\pi}{2\omega} \left[\frac{V_1}{2V_{01}} - 1 \right] \frac{2V_0}{V_1}$$

$$= \frac{\pi}{2\omega} - \frac{\pi}{\omega} \frac{V_0}{V_1}$$

$$t_1 - t_0 \approx \frac{\pi}{\omega} \frac{V_0}{V_1}$$

$$L_1 = v_0 \left(\frac{\pi}{\omega} \frac{V_0}{V_1} \right)$$