Sheet (1)

(1) Give a brief description for Microwaves?

The word Microwave is an electromagnetic waves whose frequencies range from about 300 MHz – 300 GHz and it means very short wave, which is the shortest wavelength region of the radio spectrum and a part of the electromagnetic spectrum,

(2) Calculate the wavelengths in air ranging for microwave signals?

f = 30 GHz „ $\lambda = 3 * 10^8 / 30 * 10^9 = 10$ mm
f = 300 GHz „ $\lambda = 3 * 10^8 / 300 * 10^9 = 1$ mm

(3) List the microwave frequency spectrum according to the bases of frequency bands and uses?

1. L-band (20-cm radar long band) is a portion of the microwave band of the electromagnetic spectrum ranging roughly from 0.39 to 1.55 GHz. It is used by some communication satellite and by terrestrial.
2. S-band: S-band or 10 cm. radar short band, is the part of microwave band of the electromagnetic spectrum ranging roughly from 1.55 to 5.2 GHz. It is used by weather radar and some communication satellites
3. C-band: C-band (“ Compromise” band) is a portion of electromagnetic spectrum in the microwave range of frequencies ranging from 4 to 6 GHz.
4. X-band: The X-band (3 cm radar spot band) of the microwave band of the electromagnetic spectrum roughly ranges from 5.2 to 10.9 GHz. It is used by some communication satellite and X-band radar.
5. Ku-band: The Ku-band (Kurz-under band) is a portion of electromagnetic spectrum in the microwave range of frequency range 11 to 18 GHz. It’s primarily used for satellite

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communication.
6. K-band: It is a portion of the EM wave spectrum in the microwave range of frequency range between 12 to 40 GHz. The K comes from Kurz. K-band between 18 to 26.5GHz is absorbed easily by water vapour.
7. Ka-band: The Ka-band (Kurz-above band is a portion of the K-band) of the microwave band of the electromagnetic spectrum. Ka-band roughly ranges from 18 to 40 GHz.

(4) Describe the main advantages and limitations of microwaves?

advantages

1- Increased bandwidth availability:
2- Improved directive properties:
3- Lower Power Requirement
4- Fading effect

Disadvantages

1- short surface (need many antennas , distance between each two according to earth surface curvature)
2- expansive cost for MW circuits
3- MW affected by weather.

(5) What are the main challenges of Microwave uses?

Student Quiz

(6) Why we can't use conventional MW components at higher frequencies?

Student Quiz

(7) How does the microwaves Improve directive properties?

- At microwave frequencies, it is easier to design and fabricate a

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high gain antenna as compared to low frequency signals.

Beam width $\Phi=\lambda/D=c/fD$

Φ is beam width ,λ is wavelength ,D is Directivity ,c is velocity of light

This is because of the fact that as the frequency increases ,directivity increases and beam width decreases.

(8) Show the main industrial applications of microwave devices?

Civilian infrastructure and consumer markets

- Broadcast media transmission (TV, radio), Satellite communications, Cellular (wireless) communications
- Radar, e.g., Air traffic control, Weather, Maritime, Global Positioning System
- Domestic microwave cooking

Military

- Radar, e.g., Search, Track, Missile-seeker, Weather, Testing
- Electronic countermeasures (ECM)
- High-power microwave (HPM) weapons

Scientific

- Plasma heating and fusion energy research
- Charged particle accelerators
- Atmospheric radar, Radio astronomy, Deep space communications
- Medical/Biomedical
- Spectroscopy, Materials processing research
- Ground penetrating radar

Industrial

- Testing and instrumentation, Materials processing

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- Industrial plasmas, especially for semiconductor, manufacture

(9) Focus briefly on the history about development of microwave devices?

- In 1887 , Heinrich Hertz discovered electromagnetic waves.
- Hertz analyzed that EM waves reflected as it collides with metal objects.
- In 1903 , Christian Hulsmeyer detected a chip through the fog (but he can't determine the distance)
- In 1921 , Albert Hull invented the 1st microwave oscillator (Magnetron) , it generates VHF.
- In 1939, Harry Boot && John Randall developed the magnetron to be more small dimensions and with large power (kilowatts).
- In 1937 , Russell F. Varian && Siguard , invented (Klystron) .. A tube for both oscillation and amplification.
- In 1942 , Rudolf Kompfne invented Travelling wave tube (TWT) to be used as an amplifier in satellite systems.
- Nowadays , Microwave electronic devices are used in Mobile systems, Microwave oven and Diagnosis and treatment of diseases

(10) What are the High Frequency Limitations of Conventional Tubes compared with microwave tubes?

- Conventional tubes fails to operate above 1 GHz. Reasons:

(1) Transit Time effect : The time taken by an electron to travel from cathode to anode

(2) stray reactance

  - Due to lead wire inductance

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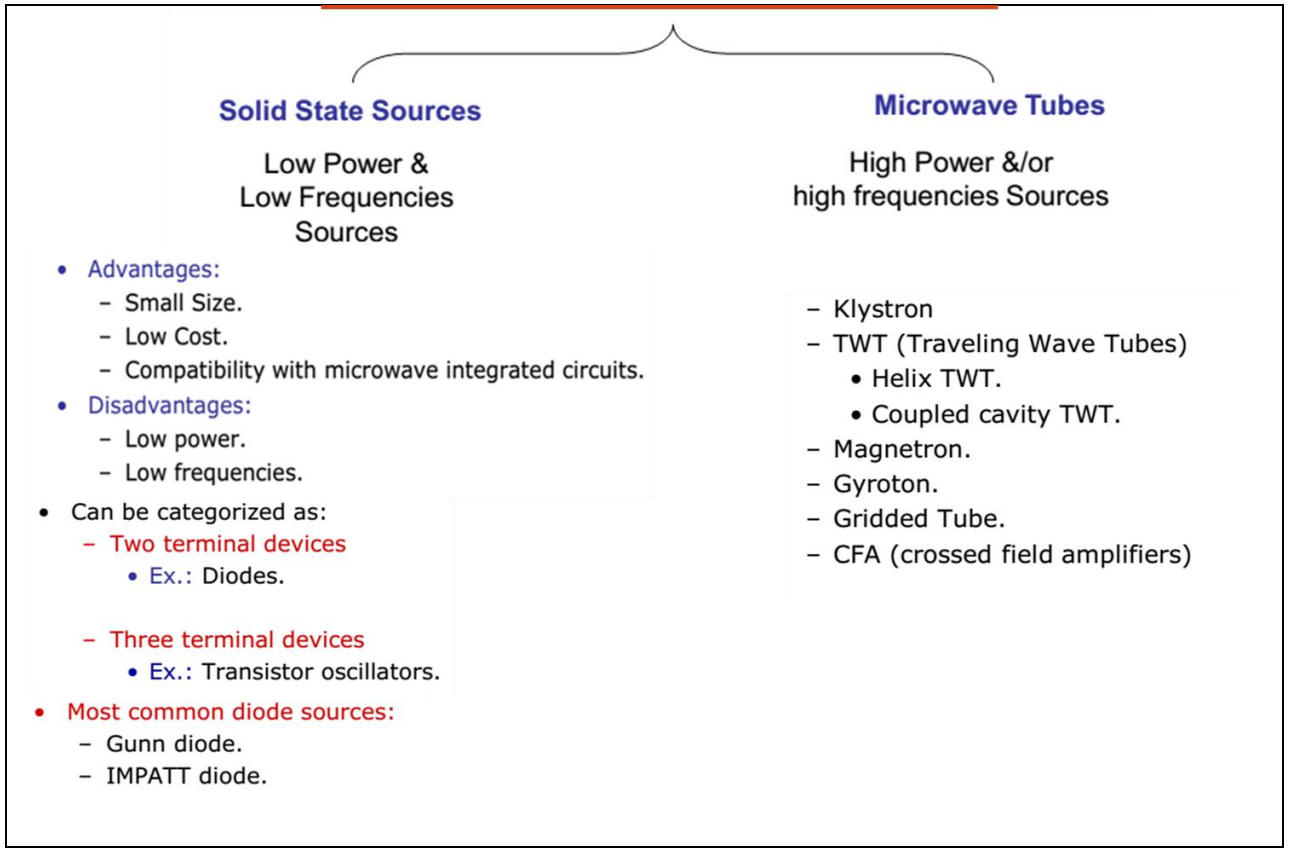
and Inter-electrode capacitance
Solution to this problem?? **Is Microwave Tubes**

(11) Mention the main types of microwave sources?



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