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Rectangular waveguide ppt presentation free template

Waveguides are difficult to install because of their rigid, hollow-pipe shape. Costs are more and decrease the practicality of waveguide systems at any other than microwave frequencies. The angles of incidence and reflection depend upon the operating frequency. Transverse Electric (TE) wave: Here only the electric field is purely transverse to the direction of propagation and the magnetic field is not purely transverse. Dielectric losses are also lower in waveguides than in two-wire and coaxial transmission lines. The size of the waveguide determines its operating frequency range. 8/29/2017 SMVITM-BANTAKAL 30 31. It is the mode for the lowest frequency that can be propagated in a waveguide. 8/29/2017 SMVITM-BANTAKAL 26 27. Thank You... 8/29/2017 SMVITM-BANTAKAL 32 The second subscript n indicates the number of half – wave variations across the diameter. (i.e.) E z = 0 and Hz = 0. Waveguides are made from copper, aluminum. (i.e.) E z = 0, Hz ≠ 0. A metallic tube can be used to transmit electromagnetic wave at the above frequencies. Definition A Hollow metallic tube of uniform cross section for transmitting electromagnetic waves by successive reflections from the inner walls of the tube is called waveguide. (i.e.) E z ≠ 0, Hz = 0. 1. Circular wave guide 8/29/2017 SMVITM-BANTAKAL 21 A Hollow metallic tube of uniform circular cross section for transmitting electromagnetic waves by successive reflections from the inner walls of the tube is called Circular waveguide. 8/29/2017 SMVITM-BANTAKAL 29 30. Commonly used printed micro strip lines support a hybrid mode, consisting of both TE and TM wave types. 8/29/2017 SMVITM-BANTAKAL 25 26. 8/29/2017 SMVITM-BANTAKAL 13 Dimensions of the waveguide which determines the operating frequency range. At frequencies above the cutoff frequency, the waveguide will propagate energy. There are an infinite number of both TEmn and TMmn modes that can propagate along such waveguides. 8/29/2017 SMVITM-BANTAKAL 24 25. 8/29/2017 SMVITM-BANTAKAL 4 5. Basic features Waveguides may be used to carry energy between pieces of equipment or over longer distances to carry transmitter power to an antenna or microwave signals from an antenna to a receiver. EM field configuration within the waveguide In order to determine the EM field configuration within the waveguide, Maxwell's equations should be solved subject to appropriate boundary conditions at the walls of the guide. TE01 mode suitable for long distance waveguide transmission above 10 GHz. Short and medium distance broad band communication (could replace / share coaxial and microwave links). Representation of modes The general symbol of representation will be TE m, n or TM m, n where the subscript m indicates the number of half wave variations of the electric field intensity along the b (wide) dimension of the waveguide. The quality factor of waveguide resonators may be by two orders of magnitude greater than that of lumped-element resonant circuits. However, waveguides are also subject to dielectric breakdown caused by standing waves. However, the disadvantage of somewhat greater size and weight. The dielectric in waveguides is air, which has a much lower dielectric loss than conventional insulating materials. The small size of the center conductor is even further reduced by skin effect and energy transmission by coaxial cable becomes less efficient than by waveguides. Conclusion Electromagnetic waves can be guided along a desired route not only by transmission lines but also by hollow pipes, dielectric coated surfaces, or dielectric rods. 8/29/2017 SMVITM-BANTAKAL 22 23. However, because the longitudinal components of the electric and magnetic field vectors are small, we can approximately treat the wave as a "quasi-TEM" wave, similar to that in a transmission line. Transverse Magnetic (TM) wave: Here only magnetic field is transverse to the direction of propagation and the electric field is not purely transverse. 8/29/2017 SMVITM-BANTAKAL 18 19. The second subscript n indicates the number of half wave variations of the electric field in the a (narrow) dimension of the guide. Applications of circular waveguide Rotating joints in radars to connect the horn antenna feeding a parabolic reflector (which must rotate for tracking). Wave paths in a waveguide at various frequencies 8/29/2017 SMVITM-BANTAKAL 15 (b) At medium frequency (c) At low frequency (a) At high frequency (d) At cutoff frequency 16. Possible Types of modes 1. Dimensions of the waveguide which determines the operating frequency range: 1. When the operating frequency is reaches the cutoff frequency of the waveguide, the signal simply bounces back and forth directly between the side walls of the waveguide and has no forward motion. 8/29/2017 SMVITM-BANTAKAL 10 11. Although energy transfer in coaxial cable is caused by electromagnetic field motion, the magnitude of the field is limited by the size of the current-carrying area of the inner conductor. The electric and magnetic fields associated with the signal bounce off the inside walls back and forth as it progresses down the waveguide. This mode is therefore termed the Dominant mode. 8/29/2017 SMVITM-BANTAKAL 19 20. Rectangular Waveguides Any shape of cross section of a waveguide can support electromagnetic waves of which rectangular and circular waveguides have become more common. 8/29/2017 SMVITM-BANTAKAL 5 6. This gives a cutoff frequency that is below the operating frequency, thereby ensuring that the signal will be propagated down the line. At cut off frequency and below, no energy will propagate. At high frequencies, the angles are large and therefore, the path between the opposite walls is relatively long as shown in Fig. Waves of frequencies lower than the cut-off frequency, known as evanescent modes, are exponentially attenuated and do not propagate at all. The width of a waveguide must be approximately a half wavelength at the frequency of the wave to be transported. 8/29/2017 SMVITM-BANTAKAL 3 4. Special couplings at the joints are required to assure proper operation. It is typical of all these hollow waveguides that (1) they cannot support the TEM wave type, but support the TE and TM wave types and (2) they cannot transmit energy below a certain frequency, known as the Cut-off frequency. Waveguides can handle more power than coaxial lines of the same size because power-handling capability is directly related to the distance between conductors. 8/29/2017 SMVITM-BANTAKAL 31 32. Expression for cut off wavelength For a standard rectangular waveguide, the cutoff wavelength is given by, 8/29/2017 SMVITM-BANTAKAL 20 22 2 b n a m c Where a and b are measured in centimeters 21. Waves of frequencies above the cut-off frequency propagate without attenuation (except due to losses in materials). 8/29/2017 SMVITM-BANTAKAL 27 28. This is due to the losses that occur both in the solid dielectric needed to support the conductor and in the conductors themselves. Hybrid (HE) wave: Here neither electric nor magnetic fields are purely transverse to the direction of propagation. Other types of wave guides 8/29/2017 SMVITM-BANTAKAL 23 24. Such solutions give rise to a number of field configurations. It has the advantage of greater power – handling capacity and lower attenuation for a given cutoff wavelength. Disadvantages Physical size is the primary lower-frequency limitation of waveguides. These metals are extruded into long rectangular or circular pipes. 8/29/2017 SMVITM-BANTAKAL 28 29. The higher-order modes (with larger m and n values) for the same waveguide must be of increasingly higher frequencies. Power-handling capability is another advantage of waveguides. Skin effect tends to increase the effective resistance of the conductor. 8/29/2017 SMVITM-BANTAKAL 12 13. Presentation By: AVINASH 4MW11EC402 2. 3. 22. A waveguide having rectangular cross section is known as Rectangular waveguide. The polarization of the transmitted wave can be altered due to the minor irregularities of the wall surface of the circular guide, whereas the rectangular wave guide the polarization is fixed. Can operate only above certain frequencies. The following are the different modes possible in a waveguide system. 14. 8/29/2017 SMVITM-BANTAKAL 11 12. 3. The circular waveguide is used in many special applications in microwave techniques. The first subscript m indicates the number of full – wave variations of the radial component of the electric field around the circumference of the waveguide. Advantages Waveguides have several advantages over two-wire and coaxial transmission lines. At lower frequency, the angles decrease and the path between the sides shortens. 2. At the cutoff frequency and below, the waveguide will not transmit energy. Each configuration is known as a mode. The TE 1, 0 mode has the longest operating wavelength and is designated as the dominant mode. Description The wave of lowest frequency or the dominant mode in the circular waveguide is the TE11 mode. So there is a frequency range in which only one mode, the TE10 mode, can propagate. 8/29/2017 SMVITM-BANTAKAL 6 7. The frequency of operation is determined by the dimension 'a'. To reduce attenuation loss. Cut off frequency The exact size of the wave guide is selected based on the desired operating frequency. Transverse Electro Magnetic (TEM) wave: Here both electric and magnetic fields are directed components. This dimension is usually made equal to one – half the wavelength at the lowest frequency of operation, this frequency is known as the waveguide cutoff frequency. 8/29/2017 SMVITM-BANTAKAL 16 17. (i.e.) E z ≠ 0, Hz ≠ 0. An electromagnetic energy to be carried by a waveguide is injected into one end of the waveguide. CONTENTS Wave guides Basic features Rectangular Wave guide Circular Wave guide Advantages Disadvantages Applications Conclusion 8/29/2017 SMVITM-BANTAKAL 2 3. Components of Electric and Magnetic Field Intensities in an EM wave 8/29/2017 SMVITM-BANTAKAL 8 9. 8/29/2017 SMVITM-BANTAKAL 17 18. 8/29/2017 SMVITM-BANTAKAL 9 10. 8/29/2017 SMVITM-BANTAKAL 14 15. 8/29/2017 SMVITM-BANTAKAL 7 8. Wave propagation When a probe launches energy into the waveguide, the electromagnetic fields bounce off the side walls of the waveguide as shown in the above diagram. The size of the waveguide is chosen so that its rectangular width is greater than one – half the wavelength but less than the one wavelength at the operating frequency. 4. Introduction At frequencies higher than 3 GHz, transmission of electromagnetic energy along the transmission lines and cables becomes difficult. Among hollow metallic waveguides, the most important are those of rectangular cross section.

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