

## INTRODUCTION TO TRANSMISSION LINES AND WAVEGUIDES

A **TRANSMISSION LINE** is a device designed to guide electrical energy from one point to another. It is used, for example, to transfer the output rf energy of a transmitter to an antenna. This energy will not travel through normal electrical wire without great losses. Although the antenna can be connected directly to the transmitter, the antenna is usually located some distance away from the transmitter. On board ship, the transmitter is located inside a radio room, and its associated antenna is mounted on a mast. A transmission line is used to connect the transmitter and the antenna.

The transmission line has a single purpose for both the transmitter and the antenna. This purpose is to transfer the energy output of the transmitter to the antenna with the least possible power loss. How well this is done depends on the special physical and electrical characteristics (impedance and resistance) of the transmission line.

### TRANSMISSION LINE THEORY

The electrical characteristics of a two-wire transmission line depend primarily on the construction of the line. The two-wire line acts like a long capacitor. The change of its capacitive reactance is noticeable as the frequency applied to it is changed. Since the long conductors have a magnetic field about them when electrical energy is being passed through them, they also exhibit the properties of inductance. The values of inductance and capacitance presented depend on the various physical factors that we discussed earlier. For example, the type of line used, the dielectric in the line, and the length of the line must be considered. The effects of the inductive and capacitive reactance of the line depend on the frequency applied. Since no dielectric is perfect, electrons manage to move from one conductor to the other through the dielectric. Each type of two-wire transmission line also has a conductance value. This conductance value represents the value of the current

flow that may be expected through the insulation. If the line is uniform (all values equal at each unit length), then one small section of the line may represent several feet. This illustration of a two-wire transmission line will be used throughout the discussion of transmission lines; but, keep in mind that the principles presented apply to all transmission lines. We will explain the theories using **LUMPED CONSTANTS** and **DISTRIBUTED CONSTANTS** to further simplify these principles.

### LUMPED CONSTANTS

A transmission line has the properties of inductance, capacitance, and resistance just as the more conventional circuits have. Usually, however, the constants in conventional circuits are lumped into a single device or component. For example, a coil of wire has the property of inductance. When a certain amount of inductance is needed in a circuit, a coil of the proper dimensions is inserted. The inductance of the circuit is lumped into the one component. Two metal plates separated by a small space, can be used to supply the required capacitance for a circuit. In such a case, most of the capacitance of the circuit is lumped into this one component. Similarly, a fixed resistor can be used to supply a certain value of circuit resistance as a lumped sum. Ideally, a transmission line would also have its constants of inductance, capacitance, and resistance lumped together, as shown in figure 3-1. Unfortunately, this is not the case. Transmission line constants are as described in the following paragraphs.

### DISTRIBUTED CONSTANTS

Transmission line constants, called distributed constants, are spread along the entire length of the transmission line and cannot be distinguished separately. The amount of inductance, capacitance, and resistance depends on the length of the line, the size of the conducting wires, the spacing between the

# Ec2305 Transmission Line And Wave Guide

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Frank, Massachusetts Institute of  
Technology. Radiation Laboratory**



## **Ec2305 Transmission Line And Wave Guide:**

**Transmission Lines And Waveguide** Uday A. Bakshi, Ajay V. Bakshi, 2008 Transmission Line Theory Different types of transmission lines Definition of characteristic impedance The transmission line as a cascade of T Sections Definition of propagation constant General solution of the transmission line The two standard forms for voltage and current of a line terminated by an impedance Physical significance of the equation and the infinite line The two standard forms for the input impedance of a transmission line terminated by an impedance Meaning of reflection coefficient Wavelength and velocity of propagation Waveform distortion Distortionless transmission line The telephone cable Inductance loading of telephone cables Input impedance of lossless lines Reflection on a line not terminated by  $Z_0$  Transfer impedance Reflection factor and reflection loss T and section equivalent to lines The Line at Radio Frequencies Standing waves and standing wave ratio on a line One eighth wave line The quarter wave line and impedance matching The half wave line The circle diagram for the dissipationless line The Smith chart Application of the Smith chart Conversion from impedance to reflection coefficient and vice versa Impedance to admittance conversion and viceversa Input impedance of a lossless line terminated by an impedance Single stub matching and double stub matching Guided Waves Waves between parallel planes of perfect conductors Transverse electric and transverse magnetic waves Characteristics of TE and TM Waves Transverse electromagnetic waves Velocities of propagation Component uniform plane waves between parallel planes Attenuation of TE and TM waves in parallel plane guides Wave impedances Rectangular Waveguides Transverse magnetic waves in rectangular wave guides Transverse electric waves in rectangular waveguides Characteristic of TE and TM waves Cut off wavelength and phase velocity Impossibility of TEM waves in waveguides Dominant mode in rectangular waveguide Attenuation of TE and TM modes in rectangular waveguides Wave impedances Characteristic impedance Excitation of modes Circular Wave Guides and Resonators Bessel functions Solution of field equations in cylindrical co ordinates TM and TE waves in circular guides Wave impedances and characteristic impedance Dominant mode in circular waveguide Excitation of modes Microwave cavities Rectangular cavity resonators Circular cavity resonator Semicircular cavity resonator Q factor of a cavity resonator for TE<sub>101</sub> mode

**Transmission Lines & Wave Guides** B. Somanathan Nair, Transmission Lines & Waveguides Uday A. Bakshi, Late Ajay V. Bakshi, 2020-11-01 The book is written for an undergraduate course on the transmission lines and waveguides It provides comprehensive coverage of four terminal networks filters transmission lines and various types of waveguides The book starts with explaining the symmetrical and asymmetrical four terminal networks which form the basis of filters Then book provides the detailed discussion of various types of filters The discussion of composite filters and crystal filter is also included in the book The book covers the transmission line parameters in detail along with reflection on a line reflection loss and reflection factor The chapter on transmission line at radio frequency includes parameters of line at high frequency standing waves standing wave ratio single stub matching double stub matching and Smith chart The book covers

the various aspects of guided waves between parallel planes It also provides the discussion of rectangular and circular waveguides At the end book incorporates the discussion of resonators Each chapter provides the detailed explanation of the topic practical examples and variety of solved problems The explanations are given using very simple and lucid language All the chapters are arranged in a specific sequence which helps to build the understanding of the subject in a logical fashion The book explains the philosophy of the subject which makes the understanding of the concepts very clear and makes the subject more interesting

**Transmission Lines and Waveguides** Lamont V. Blake,1969 *Transmission Lines, Waveguides, and Smith Charts* Richard L. Liboff,G. Conrad Dalman,1985 Transmission Lines and Wave Propagation

Philip Cooper Magnusson,1965 **Transmission Lines & Waveguide** Ganesan,2010 **Transmission Lines and Wave**

**Propagation** Philip C. Magnusson,Andreas Weisshaar,Vijai K. Tripathi,Gerald C. Alexander,2017-07-12 *Transmission Lines*

and Wave Propagation Fourth Edition helps readers develop a thorough understanding of transmission line behavior as well

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electromagnetic field theory then applies Maxwell s equations for time varying electromagnetic fields to coaxial and parallel

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## **Ec2305 Transmission Line And Wave Guide** Book Review: Unveiling the Magic of Language

In a digital era where connections and knowledge reign supreme, the enchanting power of language has been apparent than ever. Its ability to stir emotions, provoke thought, and instigate transformation is really remarkable. This extraordinary book, aptly titled "**Ec2305 Transmission Line And Wave Guide**," compiled by a highly acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound impact on our existence. Throughout this critique, we will delve to the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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