# SmithSim V1.0 A Smith Chart Simulator

## **Objective:**

The objective of this software is to solve Transmission line problems just as using the Smith Chart. Line Impedance calculation, Line Length Calculation and Stub Matching are few transmission line problems, familiar to engineering students undergoing a course in Transmission Line Theory, are conventionally solved using the Smith's Impedance Chart. This software can be used as an effective tool to solve such problems using a simulated Smith Chart.

## The Software:

The software is written in C using Turbo C++ V3.0 compiler. The program is divided into four major files

#### • CCOMPLEX.H :

This file contains complex arithmetic functions, as C doesn't support complex number arithmetic operation. The file contains code for functions like addition and multiplication of two complex numbers, inverse of a complex number. It also contains the code for the Smith's Complex Transformation that maps the complex Z plane to various points in the chart. The transformation of Z is given as



The function 'transform' applies the above transformation to a complex number and returns the corresponding screen coordinates. The function 'inverse' is the inverse of the above transform that converts a given screen coordinate to a complex number in the Z plane. The inverse transformation is

$$Z = 2/(1 - U) - 1$$

# • CMOUSE.H :

This file contains the functions for the mouse interface. The codes for functions to initialize the mouse cursor, hide/show the mouse cursor, detecting the mouse click event, detecting the location of the mouse pointer and changing the mouse pointer are available in this file. Interrupt 33H (Mouse Interrupt) is used for this purpose.

#### • CGUI.H :

This file contains the Graphic user interface functions. The codes for display screen, Smith Chart Pattern, textboxes, entering numbers in graphics mode etc., is available in this file. These functions are solely meant for easy interaction of the software with the user.

#### • CCOMP.H

This file contains the computational functions for solving the problems. The file has codes to

simulate the actual Smith Chart procedure for solving different types of transmission line related problems.



The software can be used to solve three types of problems

- a) Transmission Line Impedance Calculation
- b) Transmission Line Length Calculation
- c) Single Stub Matching

# Line Impedance Calculation:

Impedance at any point P on the line can be calculated by specifying the Impedance at a particular point Q and the line length between P and Q. On clicking the 'Line Impedance' button, a window appears. The characteristic resistance Rc, complex impedance (Resistance ZX & Reactance ZY) and the Line length are to be entered. The direction in which the length is to be moved i.e. either towards generator or towards load is to be specified. Once all the data is entered the main menu is accessed by hitting ESC key. On clicking the 'Calculate' button, the impedance of the line at the required point is calculated. Both the user fed impedance and the calculated impedance are displayed along with the Line Length entered, standing wave ratio VSWR and the magnitude of the Reflection Coefficient of the transmission line.

Line Length Calculation:

Line length between two points on the transmission line can be calculated by specifying the Impedances at the two points. On clicking the 'Line Length' button, a window appears. The characteristic resistance Rc, complex impedances (Resistance ZX1, ZX2 & Reactance ZY1, ZY2) are to be entered. Again, the direction i.e. either towards generator or towards load is to be specified. Once all the data is entered the main menu is accessed by hitting ESC key. On clicking the 'Calculate' button, the line length between the two points is calculated. Both the user fed impedances are displayed along with the Line Length calculated, standing wave ratio VSWR and the magnitude of the Reflection Coefficient of the transmission line.

#### Single Stub Matching:

The length and the position of a short-circuited stub can be calculated by specifying the Load Impedance. On clicking the 'Single Stub' button, a window appears. The characteristic resistance Rc, complex impedance (Resistance ZX & Reactance ZY) is to be entered. Once all the data is entered the main menu is accessed by hitting ESC key. On clicking the 'Calculate' button, the Length and the Position of the required shorted-circuited stub are calculated. The entered Load Impedance, the characteristic impedance circle and the impedance at the point where the stub is to be placed are displayed along with the Length of the Stub and it's position.

On clicking the 'Clear' button, the chart is cleared for further calculations. The program can be terminated either clicking the 'Exit' button or pressing the ESC key.

#### Note:

The Borland Graphics Interface file EGAVGA.BGI and the font file LITT.CHR are to be include in the source code directory for proper compilation and execution. To run the software under DOS the mouse driver has to be installed.