Experiment No. 4

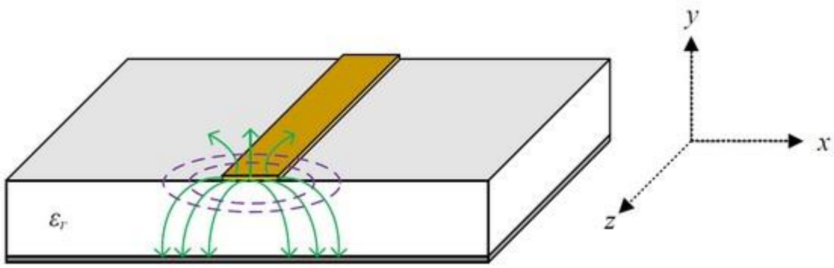
Aim: To obtain a layout on paper of the microstrip specification design using AppCAD

Apparatus: AppCad

Theory:

A microstrip is a type of transmission line that consists of a conductor fabricated on dielectric substrate with a grounded plane. It is easily miniaturized and integrated with microwave devices making it a popular choice of transmission line.

A microstrip line consists of a conductor of width W, a dielectric substrate of thickness h and permittivity ε_r. The presence of the dielectric (commonly thin with $h \ll \lambda$) concentrates the field lines in the region between the between the conductor and the ground plane, with some fraction being in the air region above the conductor, leading to quasi-TEM modes of propagation in which dispersion occurs as a function of wavelength as shown in Fig. below.



The phase velocity and propagation constant is given by

$$v_p = \frac{c}{\sqrt{\varepsilon_e}}$$

$$\beta = k_0\sqrt{\varepsilon_e}$$

With the effective dielectric constant, ε_e of the microstrip line satisfying the relation:

$$1 < \varepsilon_e < \varepsilon_r$$

Procedure:

Parameter **Value** **Description** h 0.5 mm Thickness of the dielectric
W To be found out for Zo Width of the microstrip line l To be found out for stubs
Length of the transmission line

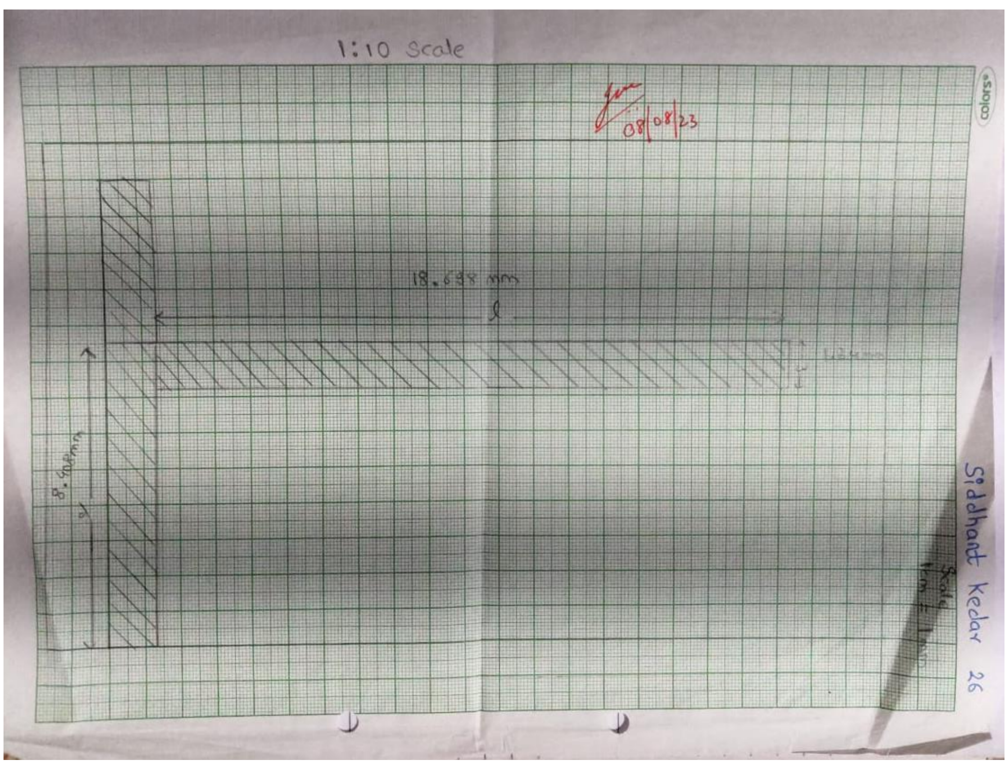
T	0.01524 mm	Thickness of copper conductor
εr	To be selected as given	Substrate

The tool for Smith chart calculator requires following setup.

1. The frequency of operation has to be entered.
2. W has to be altered to achieve Zo.
3. The above mentioned parameters are to be set in AppCad.
4. W & l have to be obtained to achieve the dimensions.

Observation Table:

Frequency = ______3GHz_______, W= 64 mil



Calculation:

Exp 4

1/08/23

Q] Designing a single stub open ckt matching for load of $Z_L = \cancel{200}\ 220 - j150\ \Omega$ connected to a line of char imp $75\ \Omega$ operating at 3GHz. micro-strip line (substrate = 1oz copper fr4 64mil)

microstrip line

Soln

$$0.25x = 90^\circ$$

$$x = \frac{55 \times 0.25}{90^\circ}$$

$$= 0.152\ \lambda$$

For l:

$20.63 - j33.53$ {cords of point}

$$Y_Z = \frac{1}{20.63 - j33.53}$$

$$= 0.0133 + 0.021j\ \mho$$

Add shunt inductor to reach O centre

$$\overline{Y} = \frac{Y}{Y_0} = \frac{Y}{1/Z_0} = Y \times Z_0$$

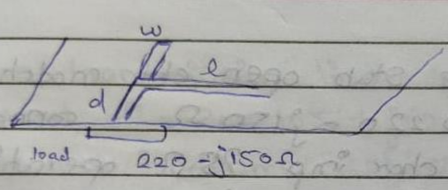
$$= 0.998 + 1.622j$$

$l = 0.338\ \lambda$ { Go to -1.622 to cancel

1 wavelength = 55.321 mm

$\therefore d = 0.152 \times 055.321 = 8.408$ mm

$l = 0.338 \times 55.321 = 18.698$ mm



$d = 8.408$ mm

$l = 18.698$ mm

$w = 1.34$ mm {from app}

Draw 1:10 scale

Conclusion: In AppCad the integrated Smith chart calculator ensured accurate impedance matching. This achievement underscores the tool's significance in bridging theory and practical implementation, enhancing the quality and performance of microstrip-based devices. In the ever-evolving landscape of microwave technology, AppCAD remains an indispensable asset for efficient and precise microstrip design.

VIVA Questions:

1) What is the mode in microstrip line ? Why?
2) Does Zo depend upon the length of the microstrip line?
3) What are the features that Zo depend upon?
4) What are the advantages and disadvantges of microstrip line?