**ECEN 452: Ultra High Frequency Techniques**

**Lab 5: TRL & Bias Tee**

**Task 1:** **Design of a TRL calibration kit.**

**Given:**

Substrate Dielectric constant er = 4.1

Substrate Dielectric Loss Tangent tan∂ = 0.01

Substrate thickness=62mil (~1.57mm)

Characteristic impedance of strips=50Ω

Frequency range= 1GHz to 5GHz

Center frequency= (f1+f2)/2 = (1+5)/2 =3GHz

Distance to reference plane=15mm

**Measurements:**

|  |  |
| --- | --- |
| **Standard** | **Length** |
| Thru | 30mm |
| Reflect | 15mm |
| Line (Calculated) | 44.06mm |
| Line (Simulated) | 43.8mm |
| Width (Calculated) | 3.09mm |
| Width (Simulated) | 3.37mm |

**Observation:**

Width of micro-strip for 50Ω lines is found to be 3.09mm using online micro-strip calculator and /4 = 14.06mm. To obtain a Z0 close to 50Ω, width had to be modified to 3.37mm. Phase of 89.76 degrees was obtained for line with /4 = 13.8mm. Slight changes in length of Line led to inversion of phase sign. 89.76 was the closest that was obtained iteratively changing values of line.

**Plots:**

The Im(Z) plot of reflect was exported to .csv file and values used to obtain capacitance using the formula:

C=-1/(2\* pi\*f\*X)

Where X is the reactance value (in negative) in the .csv file.

polyfit function was used in python to obtain a 3rd degree polynomial to fit the capacitance data so obtained.

**Task 2:** **Design of RF PIN Diode Series Switch.**

**Given:**

Substrate Dielectric constant er = 4.1

Substrate Dielectric Loss Tangent tan∂ = 0.01

Substrate thickness=62mil (~1.57mm)

Characteristic impedance of strips=50Ω

Center frequency=2.5GHz

Distance to reference plane=15mm

**Measurements:**

|  |  |
| --- | --- |
|  | **Length** |
| Width Zo=50ohms (calculated) | 3.1mm |
| Width Zo=100ohms (calculated) | 0.72mm |
| Width Zo=50ohms (simulated) | 3.35mm |
| Width Zo=100ohms (simulated) | 0.8mm |
| Length of 100ohms Line (calculated) | 17.79mm |
| Length of 100ohms Line (simulated) | 18mm |

**Observation:**

Width of micro-strip for 50Ω lines is calculated to be 3.1mm.To obtain a Z0 close to 50Ω, width had to be modified to 3.35mm. Width of micro-strip for 50Ω lines is calculated to be 0.72mm.To obtain a Z0 close to 100Ω, width had to be modified to 0.8mm.