U19EC046 LAB 2

Aim

Develop a Transmission Line of given determinations and figure its Characteristic Impedance for 100 MHz and 300 MHz utilizing AN-SOF Software.

Theory

Transmission Lines convey phone signals, PC information in LANs, TV frameworks, and signs from a transmitter to an antenna or from a antenna to a receiver. They are otherwise called circuits.
The two essential prerequisites of a transmission lines are :

1. The line ought to acquaint least weakening with the sign.
2. The line ought not emanate any of the signs as radio energy.

Types of Transmission Lines

- **Parallel Wire Line** is made of two parallel conductors separated by a space of 0.5 inch to several inches.
- The most widely used is the **Coaxial Cable**. It consists of a solid centre conductor surrounded by a dielectric material, usually a plastic such as a Teflon.
- **Twisted Pair Cable** uses two insulated solid copper wires covered with insulation and loosely twisted together.

Balanced Versus Unbalanced Transmission Lines

- Transmission Lines can be **balanced** or **unbalanced**.
- A balanced line is one in which neither wire is connected to ground.
- The signal on each wire is referenced to ground.
- In an unbalanced line, one conductor is connected to ground.
- Open wire line has a balanced configuration.

Formulas Used

The Specifications of the Transmission Line are :

Length of the Wire = l = 500 mm

Cross Section Radius of the Wire = a = 2 mm

Now, $Z_{in} = Z_0 \left(\frac{z_l \cos\beta l + j \sin\beta l}{\cos\beta l + j z_l \sin\beta l} \right) = Z_0 \left(\frac{z_l + j\tan\beta l}{1 + j z_l \tan\beta l} \right)$

$Z_{in}^{sc} = \frac{V_{sc}(l)}{I_{sc}(l)} = jZ_0 \tan\beta l$ by putting $z_l = 0$ for short circuit

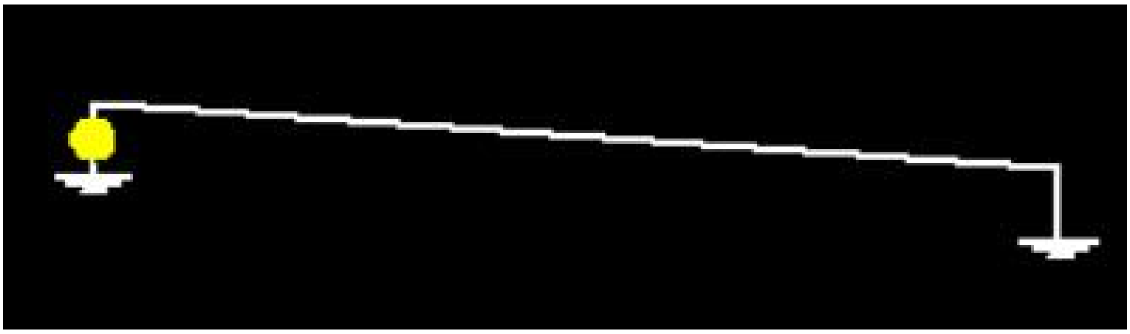
$Z_{in}^{oc} = \frac{V_{oc}(l)}{I_{oc}(l)} = -jZ_0 \cot\beta l$ by putting $z_l = \infty$ for open circuit

On the other hand, the relation for the Characteristic Impedance of a line above a ground plane is given by :

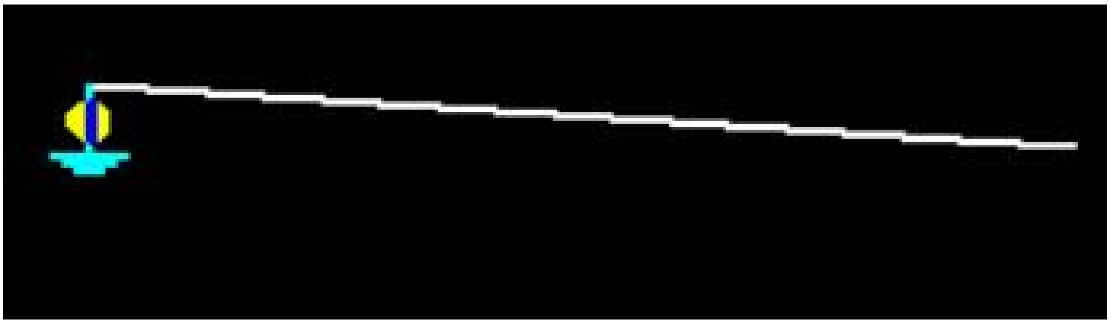
$$Z_c = 138\ \log\left(\frac{2h}{a}\right) = 138\ \log\left(\frac{2*40}{2}\right) = 221.084\ \Omega$$

where h is the height of the wire from the ground, whose value for our experiment is 40 mm.

AN-SOF Model



Short Circuit Configuration



Open Circuit Configuration

AN-SOF Output and Plots

No.	Frequency	Real (Zin)	Imag (Zin)
---	MHz	Ohm	Ohm
1	100	1.61803	511.816
2	150	33.0358	-1256.14
3	200	4.6018	-237.875
4	250	3.37284	-57.5138
5	300	4.14814	72.4372
6	350	11.5757	281.182
7	400	1338.81	2909.16
8	450	37.5496	-373.468

Short Circuit Output

No.	Frequency	Real (Zin)	Imag (Zin)
---	MHz	Ohm	Ohm
1	100	0.324032	-105.357
2	150	0.972716	26.3514
3	200	3.22702	180.884
4	250	29.3436	682.064
5	300	53.3258	-832.483
6	350	8.4624	-205.938
7	400	6.38472	-45.0189
8	450	9.11431	79.7296

Open Circuit Output

Calculations

For 100 MHz : $Z_{in}^{sc} = j511.816\,\Omega \quad Z_{in}^{oc} = -j105.357\Omega$

$$Z_c = \sqrt{Z_{sc}Z_{oc}} = 232.1412\Omega$$

For 150 MHz : $Z_{in}^{sc} = j1256.14\,\Omega \quad Z_{in}^{oc} = -j26.35\Omega$

$$Z_c = \sqrt{Z_{sc}Z_{oc}} = 181.93\Omega$$

For 200 MHz : $Z_{in}^{sc} = -j237.875\,\Omega \quad Z_{in}^{oc} = -j180.884\Omega$

$$Z_c = \sqrt{Z_{sc}Z_{oc}} = 207.43\Omega$$

For 250 MHz : $Z_{in}^{sc} = \ j57.514\Omega \ \ Z_{in}^{oc} = \ -j682.064\Omega$

$$Z_c = \ \sqrt{Z_{sc}Z_{oc}} \ = 198.061\Omega$$

For 300 MHz : $Z_{in}^{sc} = \ j72.4372\ \Omega \ \ Z_{in}^{oc} = \ -j832.483\Omega$

$$Z_c = \ \sqrt{Z_{sc}Z_{oc}} \ = 245.566\Omega$$

Conclusion

In the above Practical we executed a Transmission Line Wire utilizing AN-SOF Software and determined its Characteristic Impedance from the resultant plots which is extremely shut to the theoretical value of 221 Ω.