EE430 - Electromagnetic Theory and Applications
Project 2: Artificial Lossy Transmission Line
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Introduction:

Objectives:

Implement an artificially lossy transmission line with lumped elements and characterize the line using measurements.

Materials:

Component	No. of items	Value
Capacitor	23	0.047 μF
Inductor	21	560 μH
Resistor	4	220 Ohm

Procedure:

The circuit required to create artificially lossy transmission line will consist of capacitors and inductors, each lumped circuit element will be made to create a 'pi' formation. There will be 20 sections in series to create the transmission line.

Images:

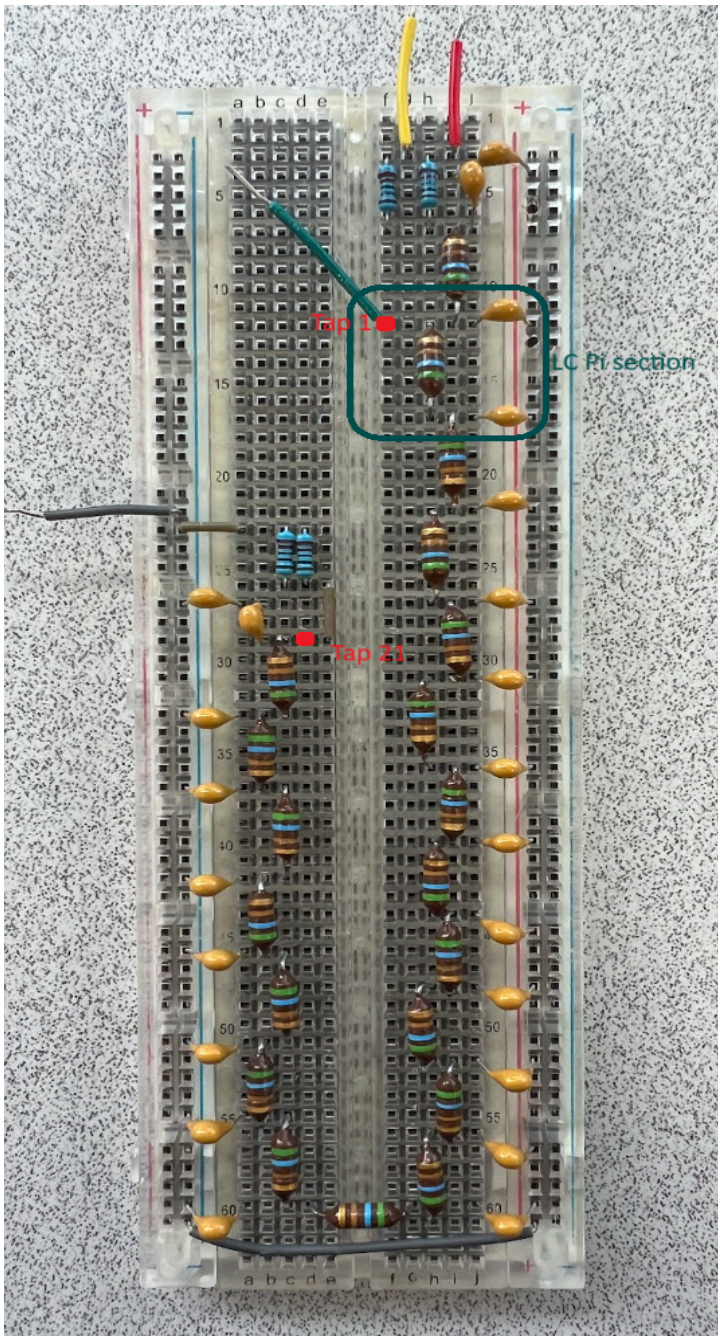

Fig. 1

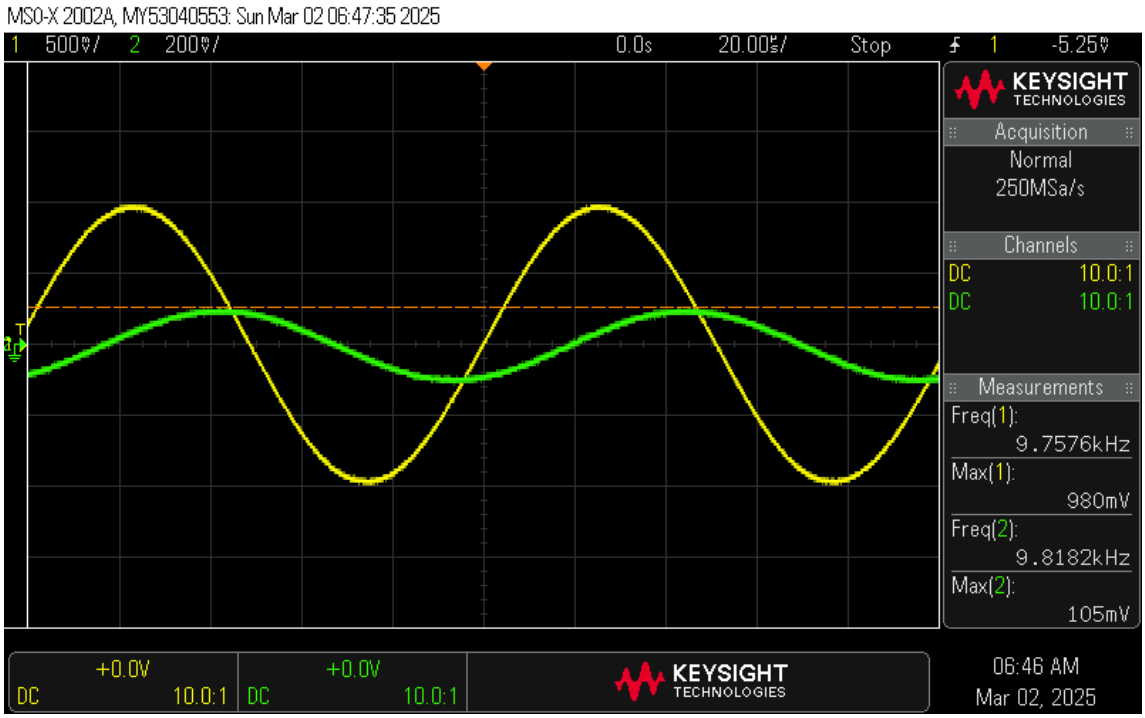

Fig. 110 Ohm load

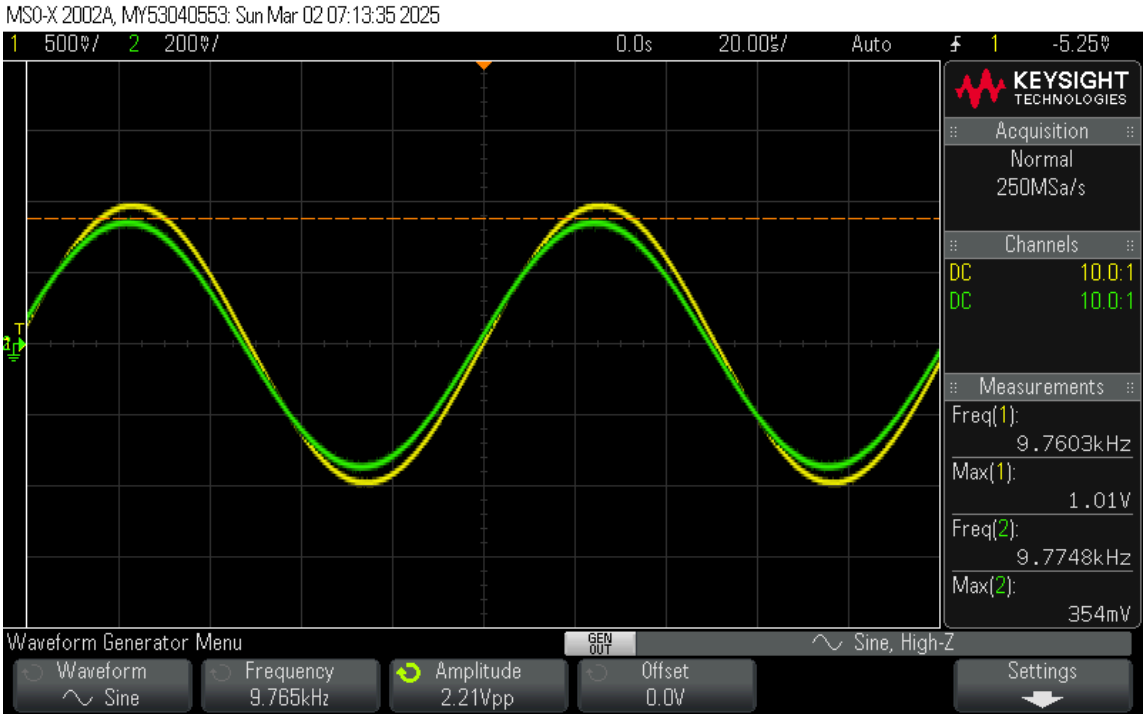

Fig. 3 Open load

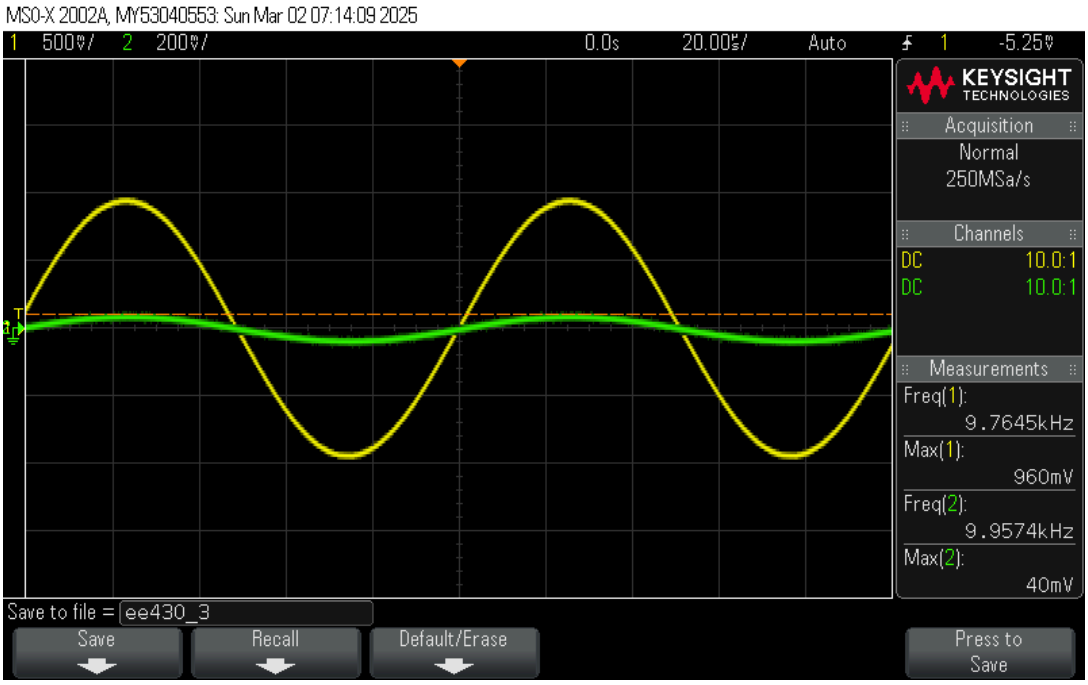

Fig. 4 Shorted load

Fig. 5 Voltage amplitude of all taps

Calculations:

Characteristic Impedance:

$$Z_o = \sqrt{\frac{L}{C}}$$

$$Z_o = \sqrt{\frac{560 \times 10^{-6}}{0.047 \times 10^{-6}}}$$

$$Z_o = 109.155\ \Omega$$

Phase Constant:

$$\beta = \omega\sqrt{LC}$$

$$\beta = 2\pi * 9765 * \sqrt{(560 \times 10^{-6})(0.047 \times 10^{-6})}$$

$$\beta = 0.314\ rad/m$$

Attenuation Constant:

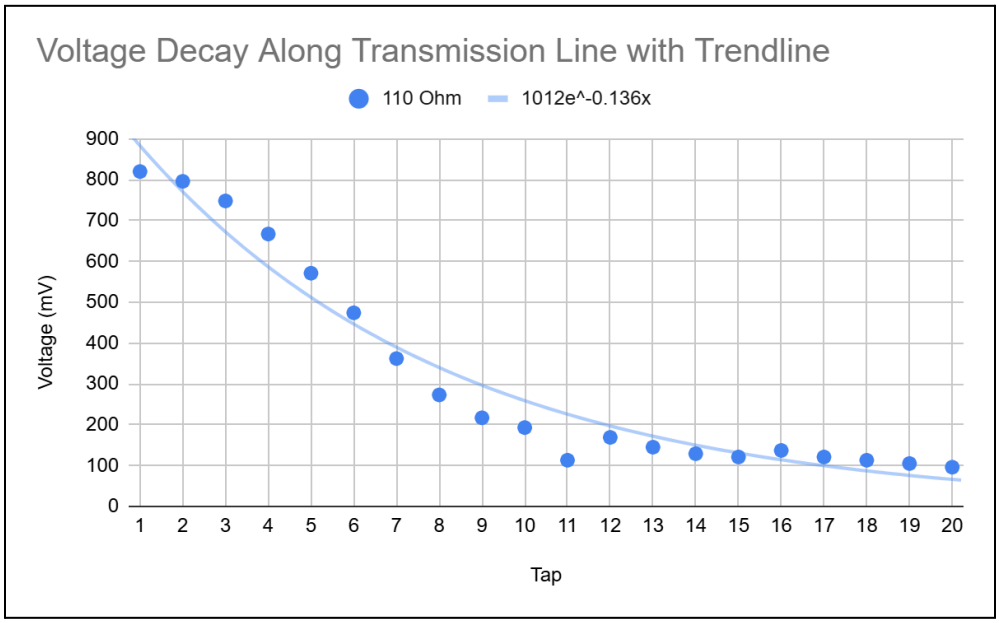

Fig. 6

According to the trendline in Fig. 6, we can see the attenuation constant of each tap is 0.136 Np/tap.
To obtain Np/m we can divide the attenuation per tap by the distance between the taps:

The distance between between separate breadboard holes = 2.54 mm
The distance between separate taps = 5 breadboard holes

$$\alpha\ (Np/m) = \frac{\alpha\ (Np/m)}{d}$$

$$\alpha\ (Np/m)\ = \frac{0.136}{5 * .00254}$$

$$\alpha = 10.71\ Np/m$$