4th Order Hairpin Bandpass Filter

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# EEL5437C Microwave Engineering

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3.6 GHz, Ripple BW = 0.24 GHz, Fourth Order, Hair Pin Structure, S11 in the ripple bandwidth: < -15 dB

Friday - 11/17/2023

The following is the design Chebyshev table,

A screenshot of a computer screen

Description automatically generated

Low pass prototype



A graph with a line

Description automatically generated

Saturday 11/18/2023

Goal: bandwidth prototype and begin filter T-line transformation.

A graph with blue lines

Description automatically generatedA graph of a graph

Description automatically generated

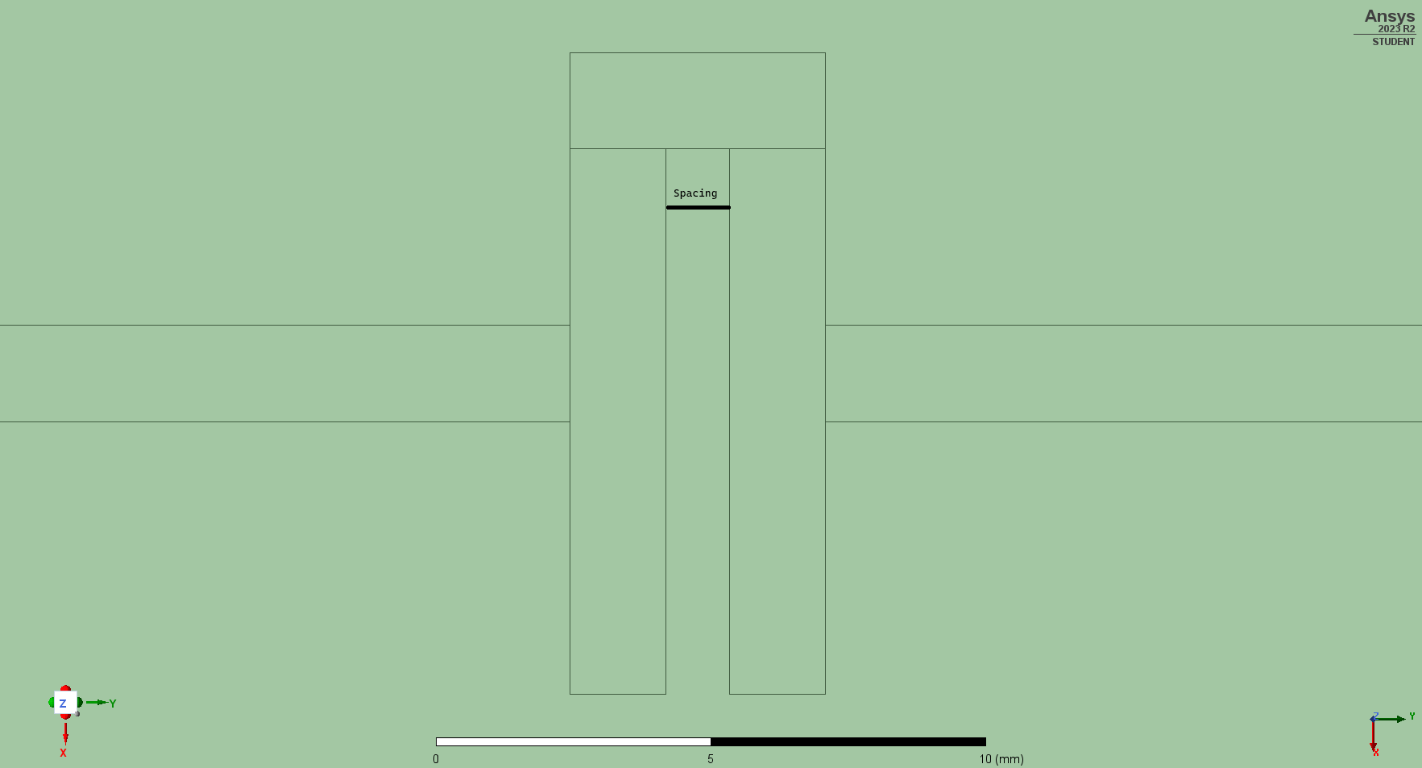
[Resonator Tuning]

A green square with a line on it

Description automatically generated with medium confidence

Initial Resonator Structure

The resonator was initially configured with a total length of λ/2; however, determining the optimal internal coupling to 3.6 GHz necessitated clarification of the appropriate spacing inside the resonator. To address this, I conducted a simulation sweep ranging from 0.1mm to 2mm, with increments of 0.025mm, in order to identify the desired spacing. The following is HFSS simulation of the sweep.

A graph of colored lines

Description automatically generatedTo ascertain the optimal spacing length, we can construct the following design chart and interpolate the spacing values accordingly.

Simulation Sweep

A graph with a line

Description automatically generated

|  |  |
| --- | --- |
| Spacing (mm) |  |
| **3.7480** | 3.798 |
| 4.2977 | 3.600 |
| 4.3726 | 3.573 |
| 4.9973 | 3.404 |
| 5.6219 | 3.349 |
| 6.2466 | 3.256 |
| 6.8713 | 3.207 |
| 7.4959 | 3.170 |

Running the simulation using a spacing of 4.2977 mm (0.172) yielded an plot centered at 3.6 GHz.

A graph of a graph

Description automatically generated

dB Plot

A graph of a function

Description automatically generated

dB Plot

[Qext synthesis]

A graph with different colored lines

Description automatically generated

offset = 1.8mm

A graph with lines and dots

Description automatically generated

offset = 2.1mm

A graph with lines and dots

Description automatically generated

offset = 2.4mm

A graph with different colored lines

Description automatically generated

offset = 2.7mm

A graph of a graph

Description automatically generated with medium confidence

offset = 3mm

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Offset (mm)** |  |  |  |  |  |  |  |
| **1.8000** | 4.007 | -7.44 | 3.92 | -97.44 | 4.091 | 82.56 | 23.43275 |
| 2.1000 | 4.018 | -8.05 | 3.912 | -98.05 | 4.122 | 81.95 | 19.13333 |
| 2.4000 | 4.028 | -6.67 | 3.907 | -96.67 | 4.149 | 83.33 | 16.64463 |
| 2.7000 | 4.012 | 0.07 | 3.871 | -89.93 | 4.15 | 90.07 | 14.37993 |
| 2.8521 | 4.023 | -3.44 | 3.876 | -93.44 | 4.172 | 86.56 | 13.59122 |
| 2.8600 | 4.018 | -0.11 | 3.868 | -90.11 | 4.166 | 89.89 | 13.48322 |
| 3.0000 | 4.023 | 0.24 | 3.863 | -89.76 | 4.182 | 90.24 | 12.61129 |

The desired are computed from Chebyshev table in the following method,

Simulation extrapolation for optimal offset,

A graph of a graph

Description automatically generated

[Coupling K simulation]

A graph of a graph

Description automatically generated

First HFSS Sweep

A graph of a graph

Description automatically generated with medium confidence