Q factor update

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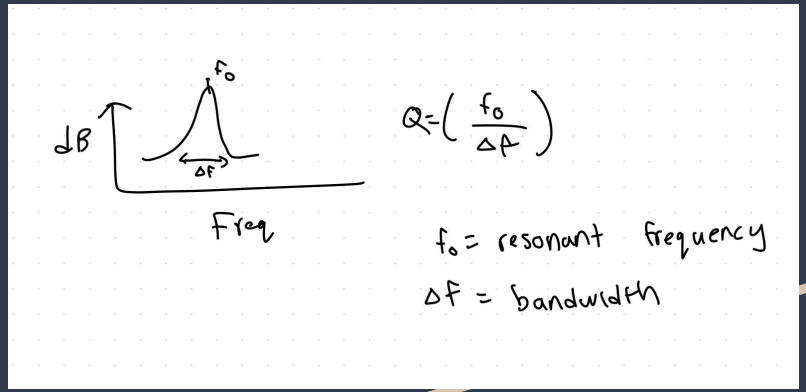
What is Q factor?



Definition: Measures energy storage vs. energy loss in resonant systems.

Meaning of High Q:

- Sharp, narrow peak in frequency response.
- Indicates low energy loss (good for MRI coils)

-Meaning of Low Q:

- Broad peak in frequency response.
- Indicates higher energy dissipation

Significance of Q: Determines system efficiency and frequency selectivity.

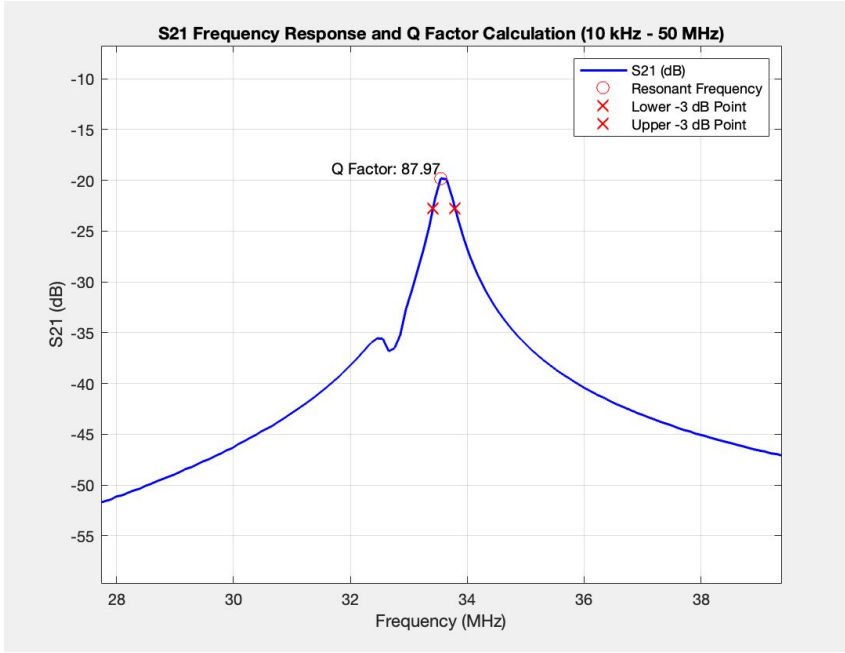
My Q factor testing

Objective:

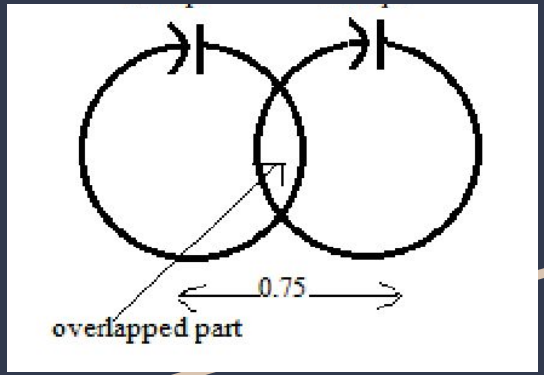
- To measure the Q-factor of future coils.
- To compare the results from the NanoVNA with those obtained from a bench-top VNA for accuracy and consistency.
- To establish a reliable method for testing coil decoupling and quality.

How I did it:

Placed a decoupled loop above a coil with an approximated Q factor of 90-100



Another example for decoupling

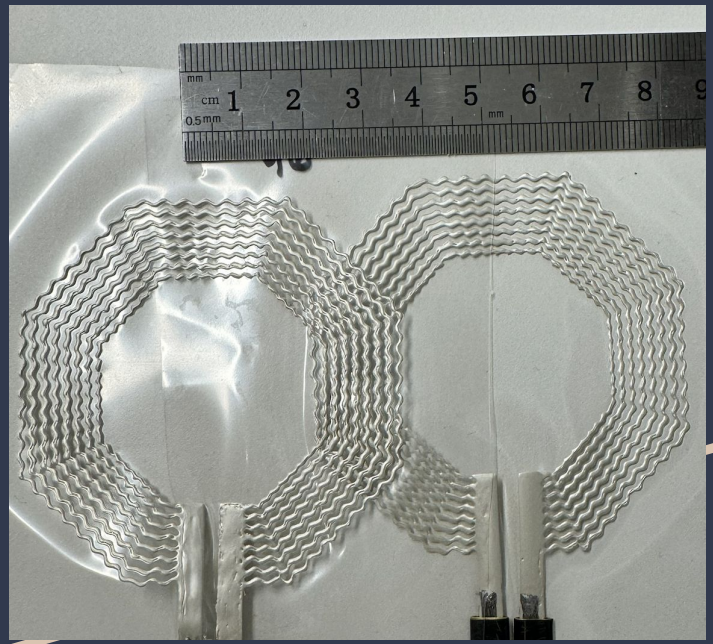


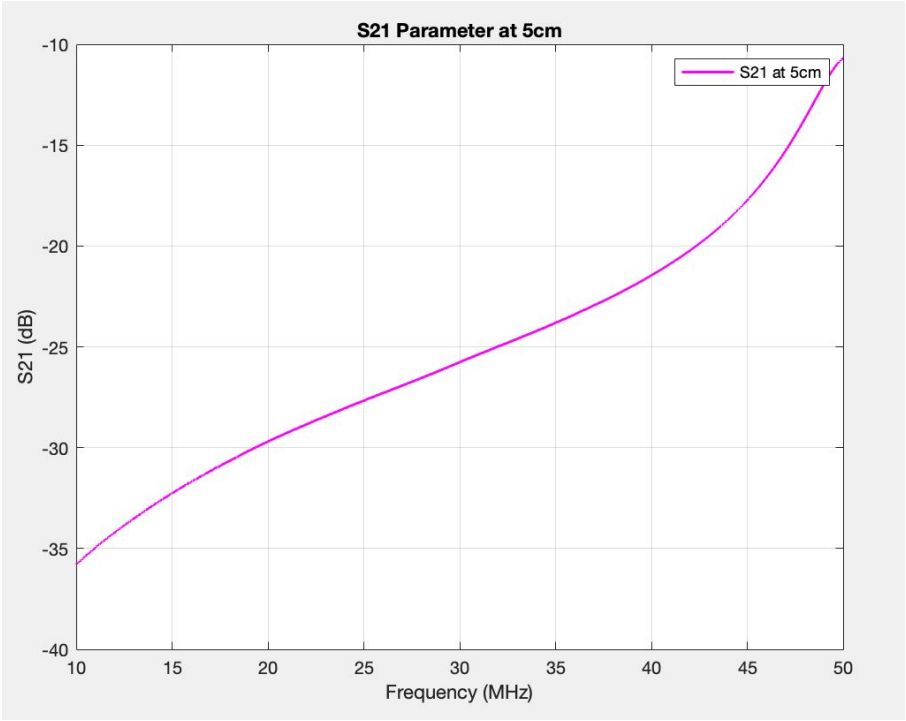
- The next experiment aims to find the minimum overlapping distance between loops to minimize coupling (S21).

- This ensures the loops are effectively decoupled, allowing independent operation and optimal performance of the coils.

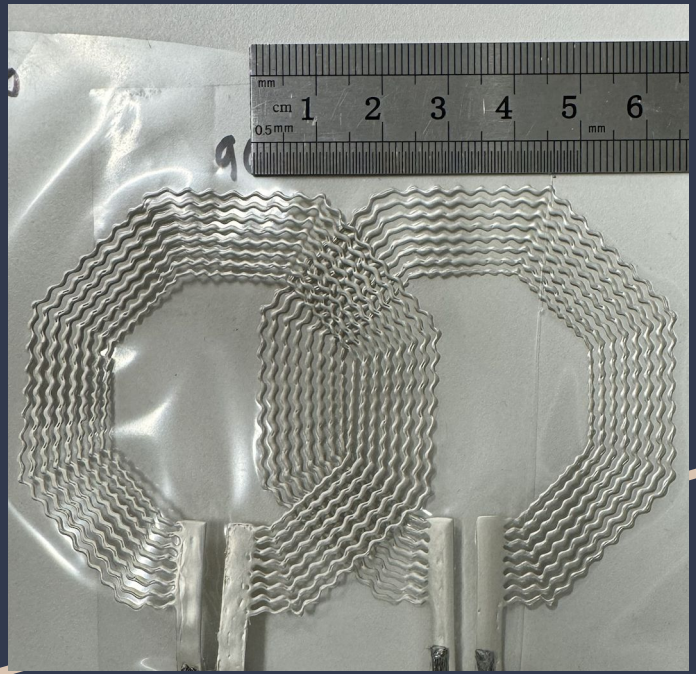
- We are trying to highlight the importance of decoupling in applications like MRI coil design, where minimal interference is critical for image quality.

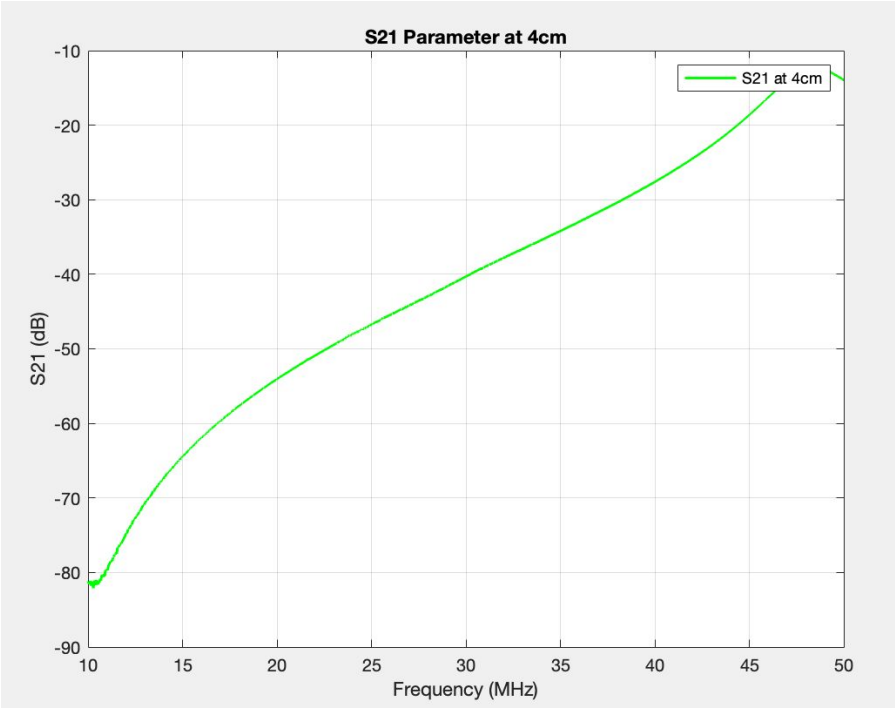
5cm


mm
cm 1 2 3 4 5 6 7 8
0.5 mm

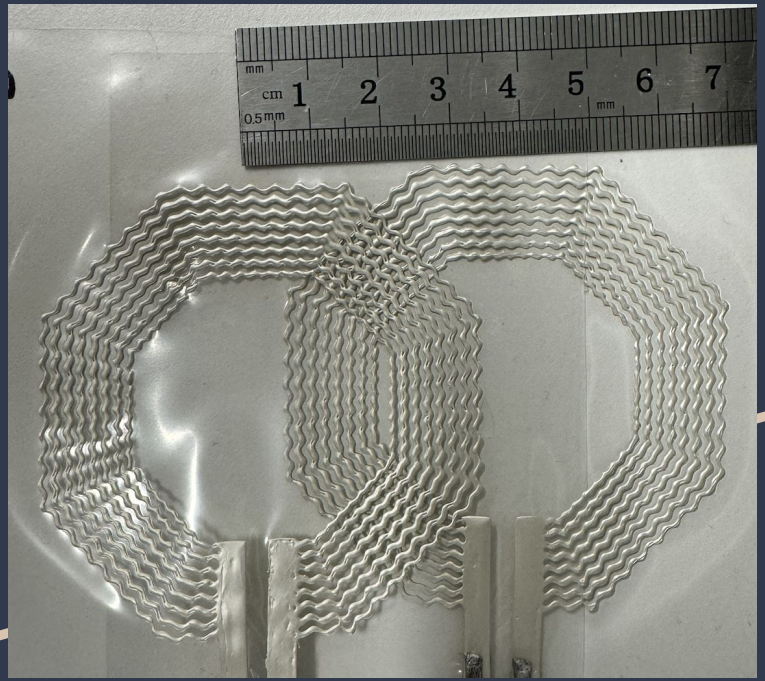

S21 Parameter at 5cm
S21 at 5cm
S21 (dB)
-10
-15
-20
-25
-30
-35
-40
10
15
20
25
30
35
40
45
50
Frequency (MHz)

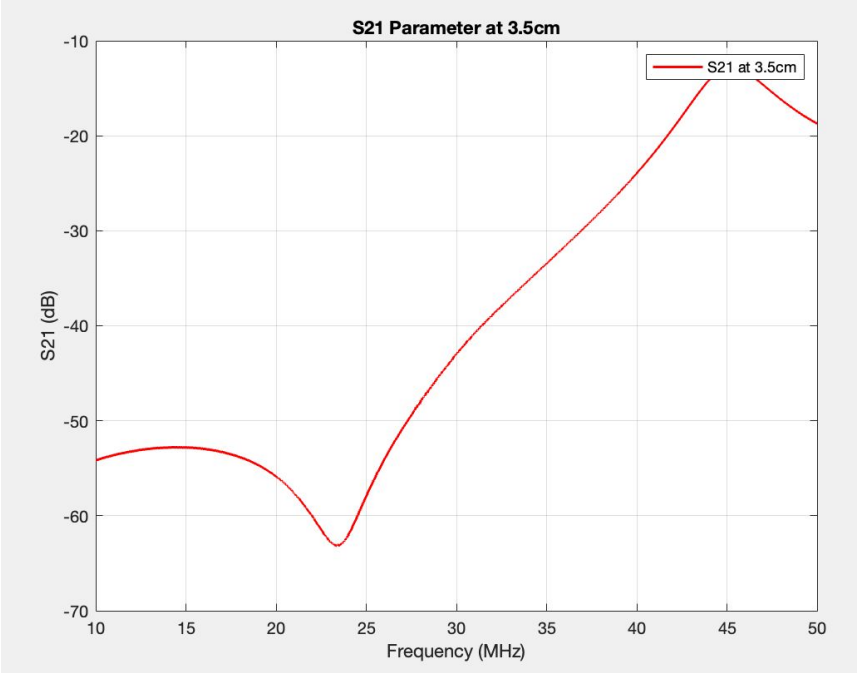
4cm


mm
cm 1 2 3 4 5 6
0.5mm
mm

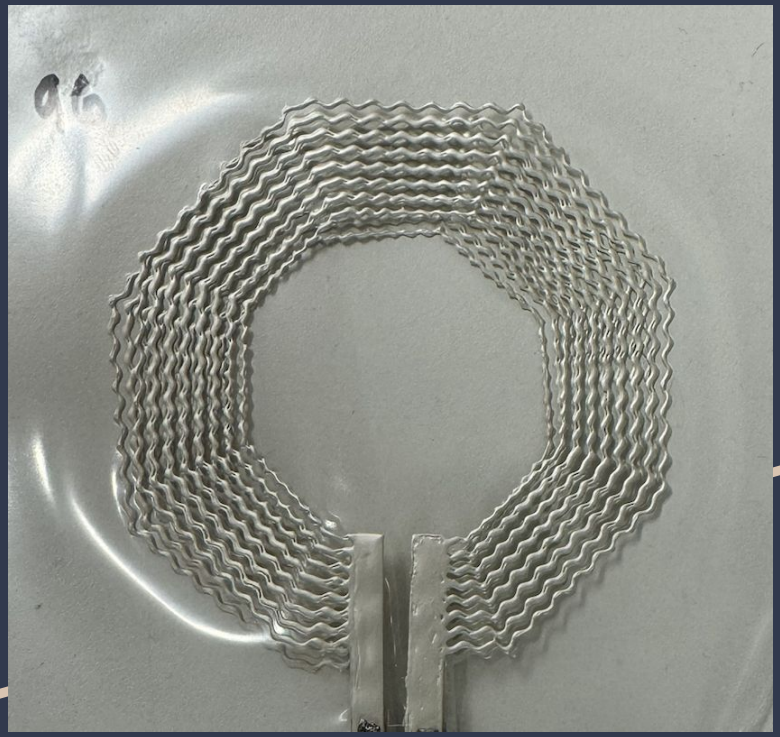

S21 Parameter at 4cm
S21 at 4cm
S21 (dB)
-10
-20
-30
-40
-50
-60
-70
-80
-90
10
15
20
25
30
35
40
45
50
Frequency (MHz)

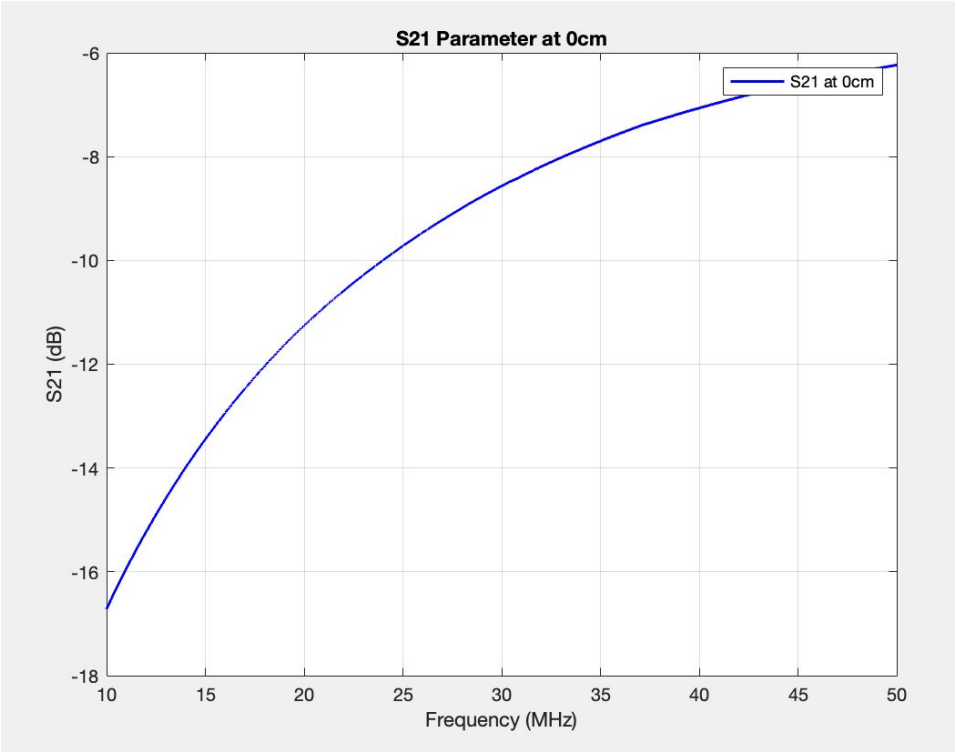
3.5cm


mm
cm 1 2 3 4 5 6 7
0.5mm
mm


S21 Parameter at 3.5cm
S21 at 3.5cm
S21 (dB)
-10
-20
-30
-40
-50
-60
-70
10
15
20
25
30
35
40
45
50
Frequency (MHz)

0cm




S21 Parameter at 0cm
S21 at 0cm
S21 (dB)
-6
-8
-10
-12
-14
-16
-18
10
15
20
25
30
35
40
45
50
Frequency (MHz)

What I Have Learned / Next Steps

Some things I learned…

- How to setup and use the NanoVNA for measuring S21 and Q-factor.
- Understanding the significance of minimizing coupling for coil performance.
- The process of comparing results from different measurement instruments (NanoVNA vs. bench-top VNA).

What's next for me…

- Measure Q-factors of various coils to build a performance baseline.
- Learn to measure impedance values for better understanding and optimization of coil designs.
- Start building and testing decoupling networks to enhance coil isolation.