Voyantic

APPLICATION NOTE

How to Measure a Metal Tag on a Metal Plate with Tagformance Pro

30.5.2024

Bill Hsieh

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1 Introduction

The purpose of this application note is to instruct users on how to measure a metal tag attached to a metal plate using Tagformance Pro both inside and outside an anechoic chamber. I will also discuss the impact of the measurement environment in this application note.

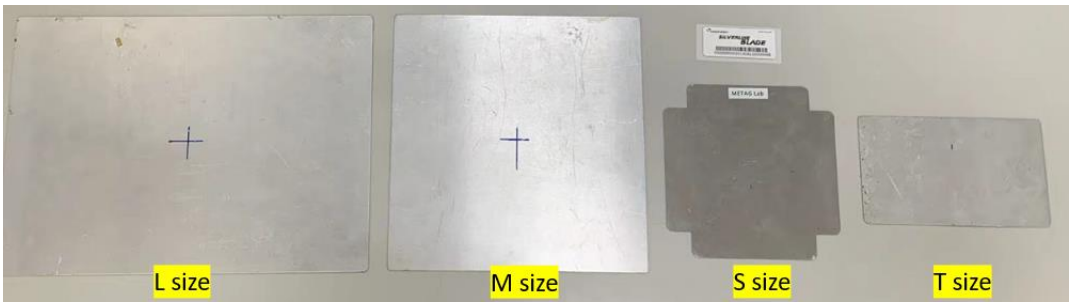
The following items were used for this test.

Tags:

- Voyantic reference tag
- Confidex SILVERLINE BLADE (Printable On-Metal Labels)
  - X=60mm, Y=25mm, Z=1.2mm

I have selected four metal plates of different sizes as follows:

- Large (L): X=297mm, Y=210mm
- Medium (M): X=210mm, Y=210mm
- Small (S): X= 140mm, Y=140mm
- Tiny (T): X= 150mm, Y=87mm



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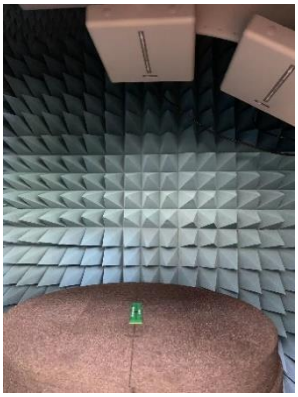
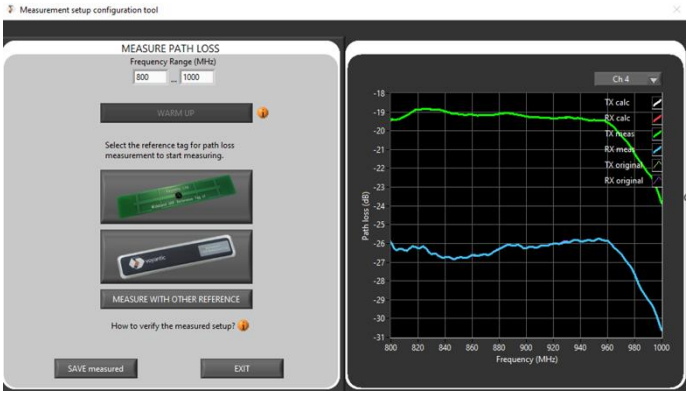
2 Inside the Chamber

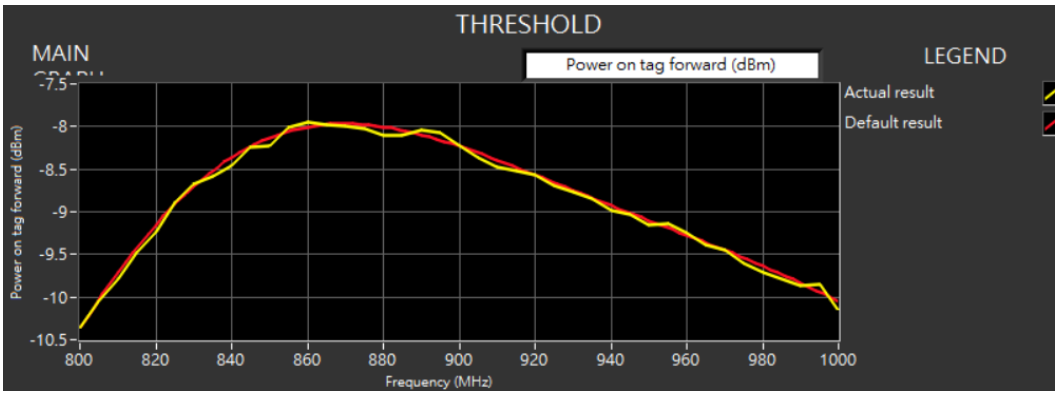
Step 1.

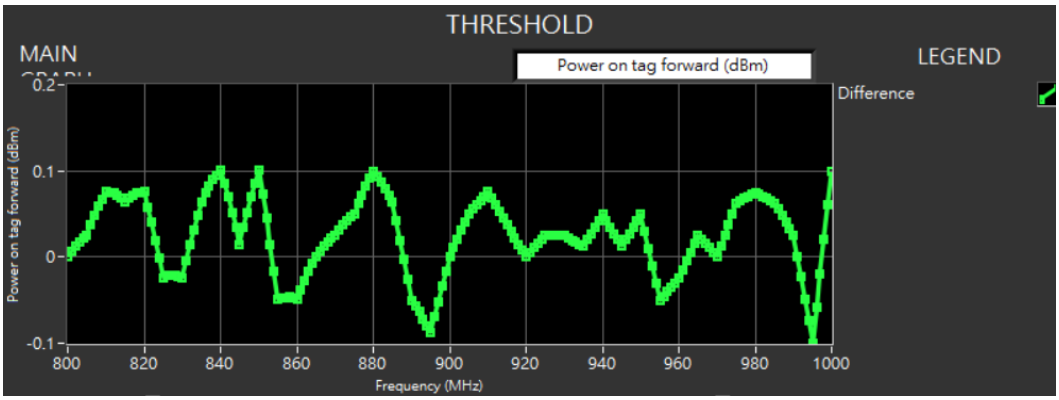
Place the Voyantic reference tag on the testing area and conduct the measured path loss.





Then, verify if the measurement environment is ready for testing. I would consider the measurement environment to be suitable if the difference between the actual result and the default result is within ±0.5 dBm in the “Power on tag forward” unit, as shown in the picture below.





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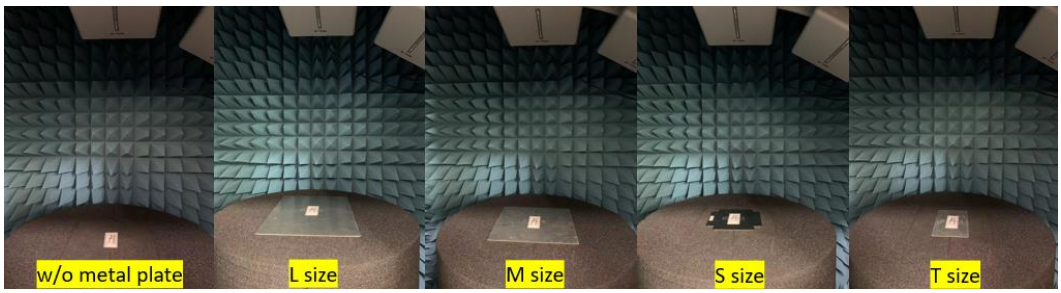
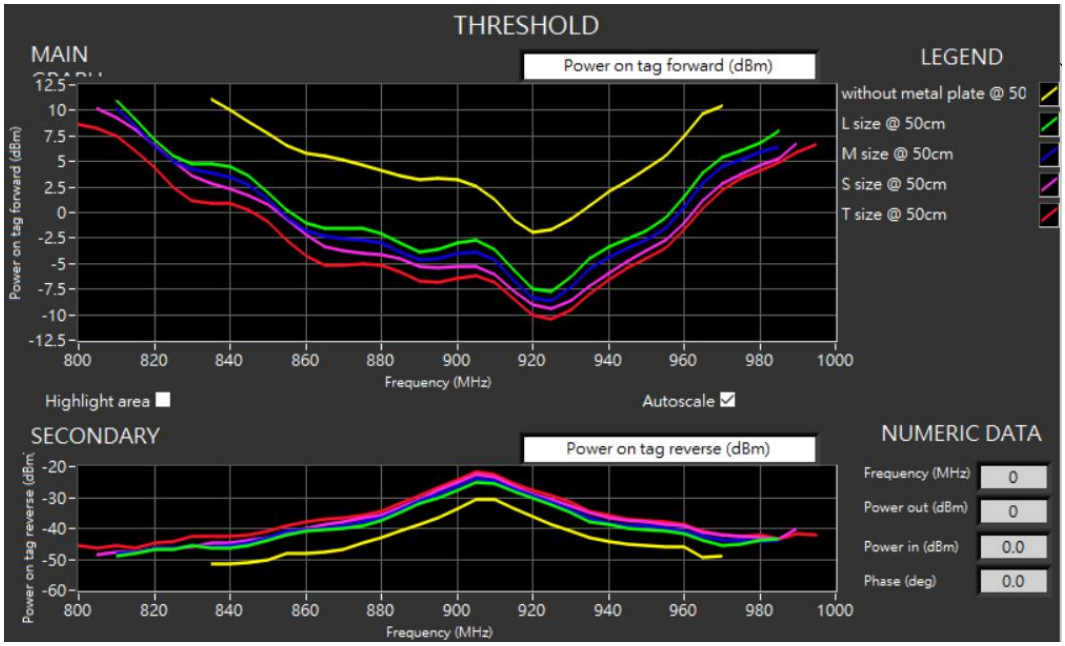
Step 2.

Place the DUT (Device Under Test) without the metal plate, and with metal plates of sizes L/M/S/T respectively. The DUT should face to the test antenna, which is ANT4 in the C50 chamber.





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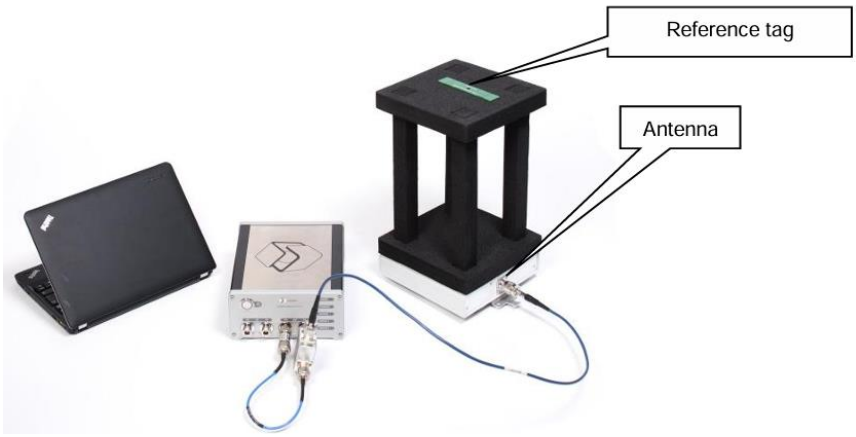
3 Outside the Chamber

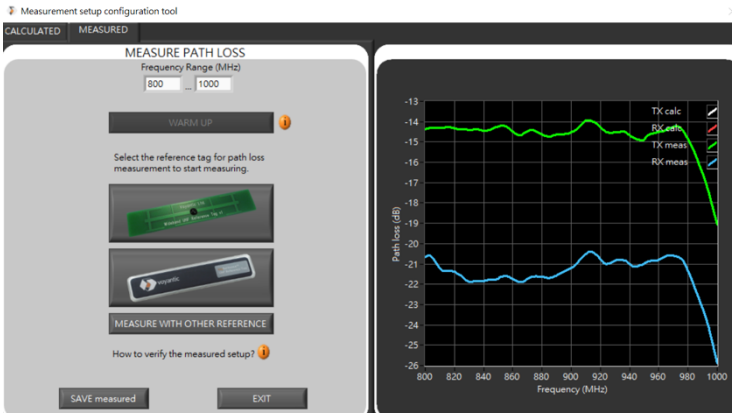
Step 1.

Find an open space and set up the hand-carry kit.



Step 2.

Place the Voyantic reference tag on the testing area and conduct the measured path loss.



Then, verify if the measurement environment is ready for testing. I would consider the measurement environment to be suitable if the difference between the actual result and the default result is within ±0.5 dBm in the “Power on tag forward” unit, as shown in the picture below.

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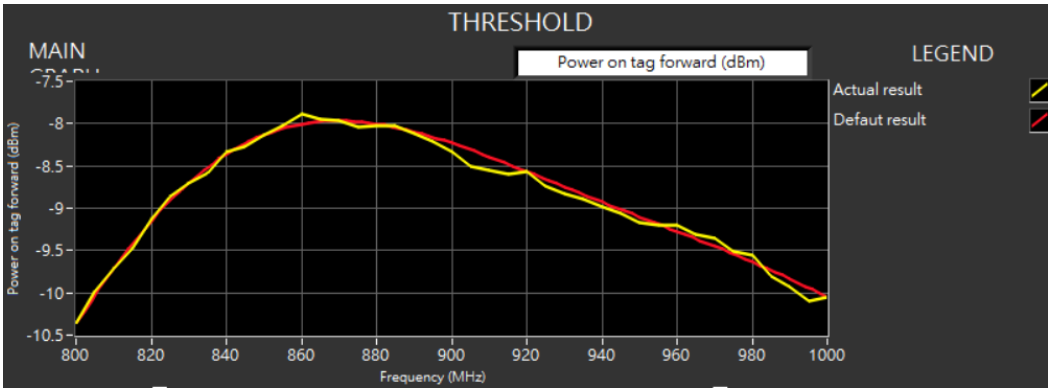
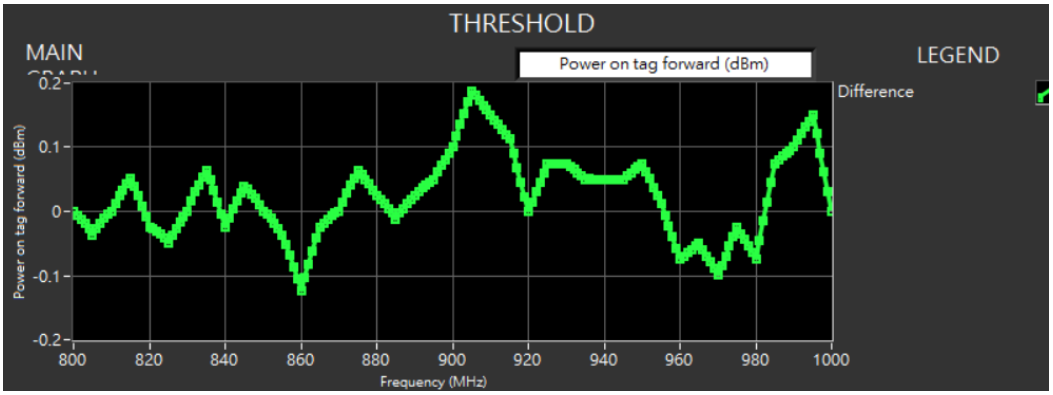
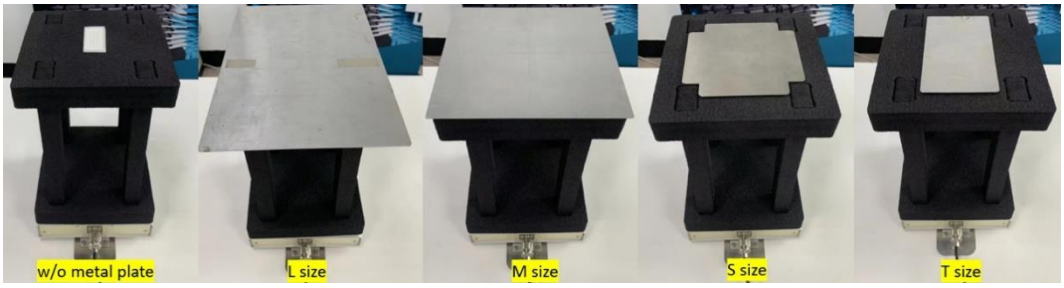




Step 3.

Place the DUT without the metal plate and with metal plates of sizes L/M/S/T respectively. The DUT should face the test antenna as shown in the pictures below.



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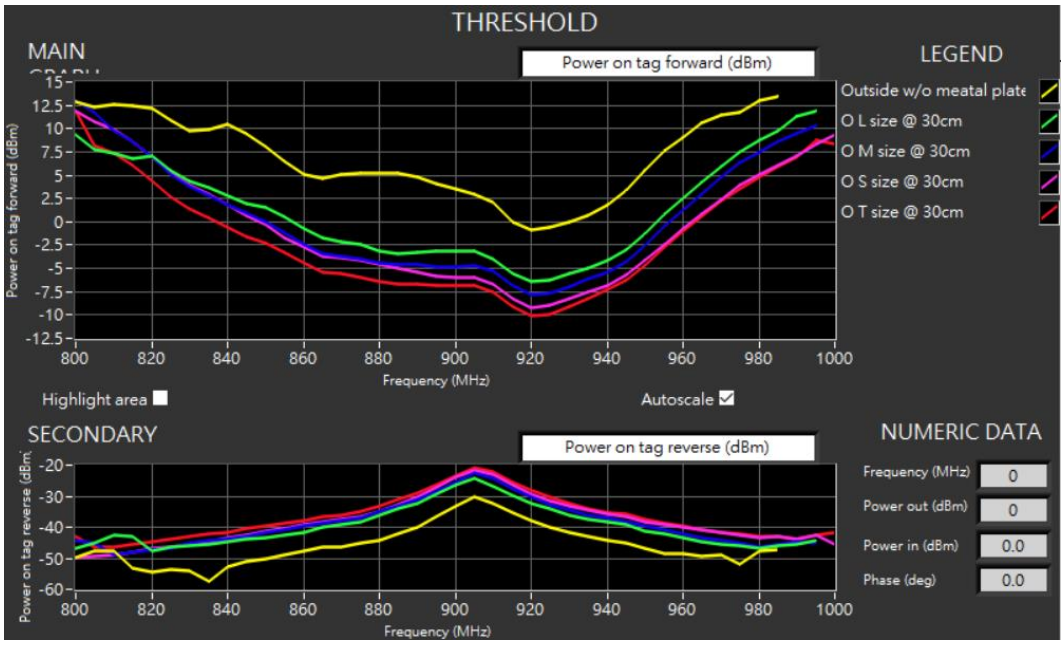

I use 'O' to represent "outside the chamber."

Based on the results from the two measurement environments (Inside the chamber / Outside the chamber) mentioned above:

- This label can achieve better performance when attached to a metal plate.
- For this label, sensitivity improves when using a smaller-sized metal plate.

4 Discussions

1. **What would be the appropriate size for the metal plate?**

I suppose there isn't a definitive answer to this question; users need to find the answer through testing. In general, you should choose a metal plate size that closely matches your real-world application. Then, you can better infer the product's performance in real-world applications.

2. **Can we obtain the same measurement results inside and outside the chamber? If not, where does the difference come from?**

This is a complex question. Firstly, we need to understand that when this label is attached to a metal plate, we must consider the entire object (label on metal plate) as a new tag. This is because the metal plate serves as a kind of antenna to enhance the transmission of RF signals. Let me break it down into several aspects

A. **In the C50 chamber**, measurements taken at distances of 50cm and 30cm, respectively, for the T-sized metal plate case showed a difference of ±1dBm in the results.

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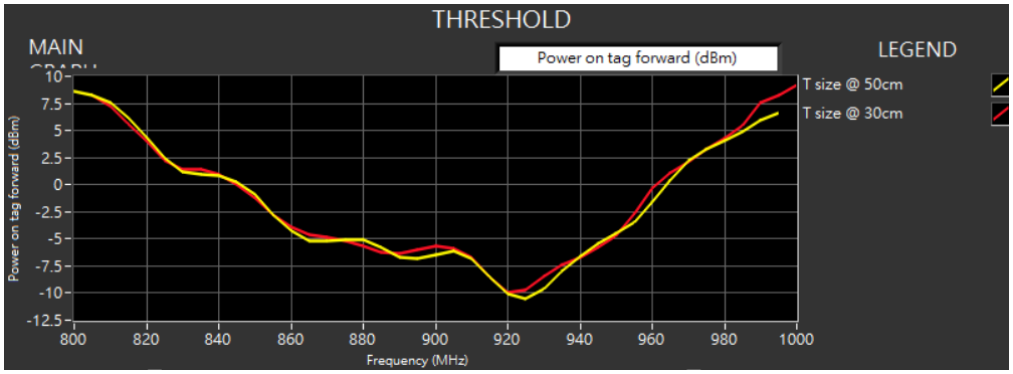
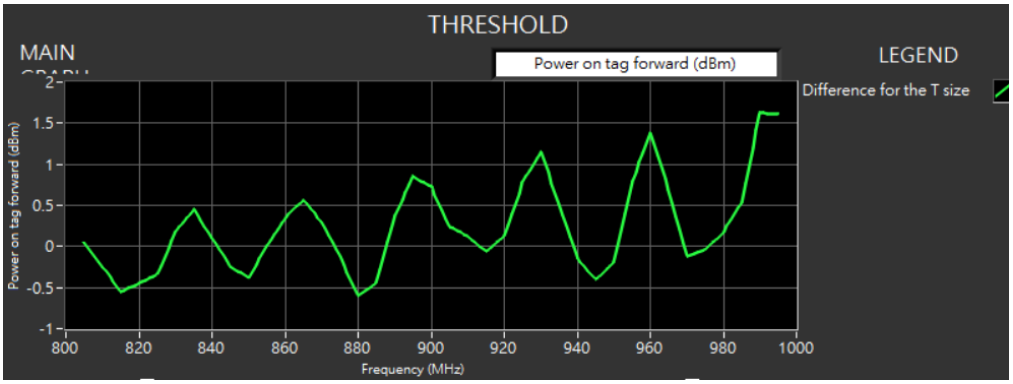
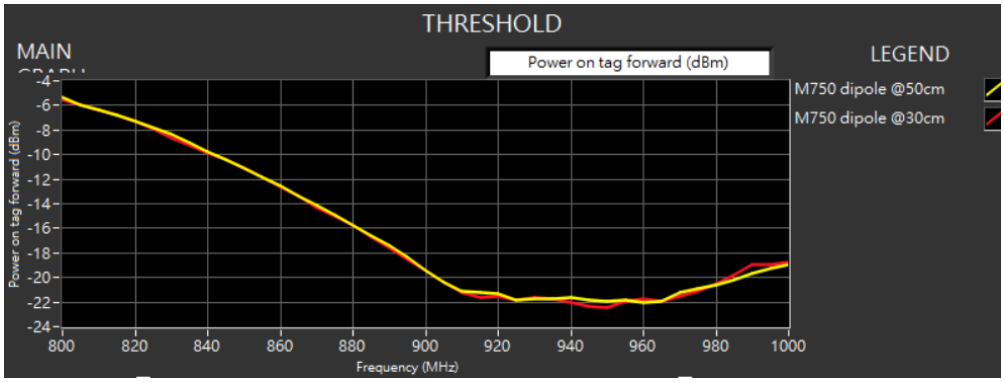




What results would we obtain if we conducted measurements under the same conditions using a normal dipole inlay? The results appear more consistent, as we expected; the difference is approximately ±0.6dBm.

Normal dipole inlay (inlay from www.arizontw.com)



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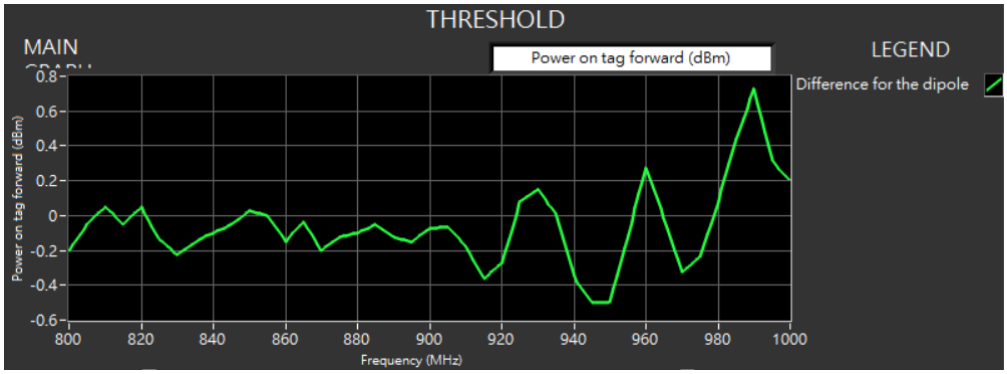
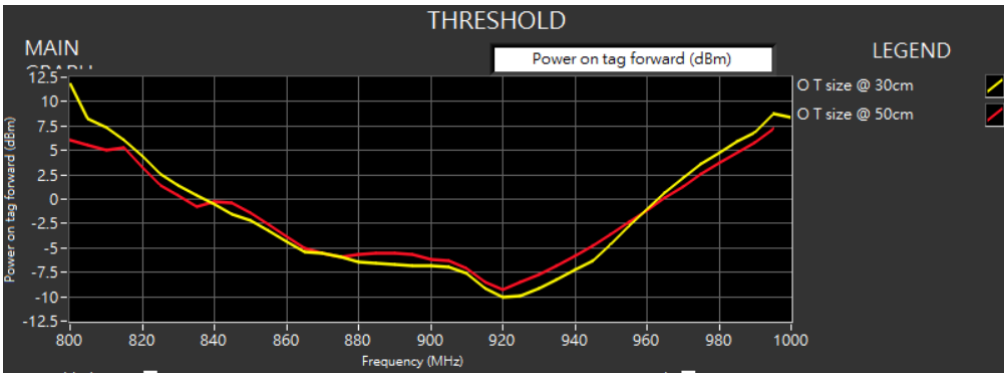
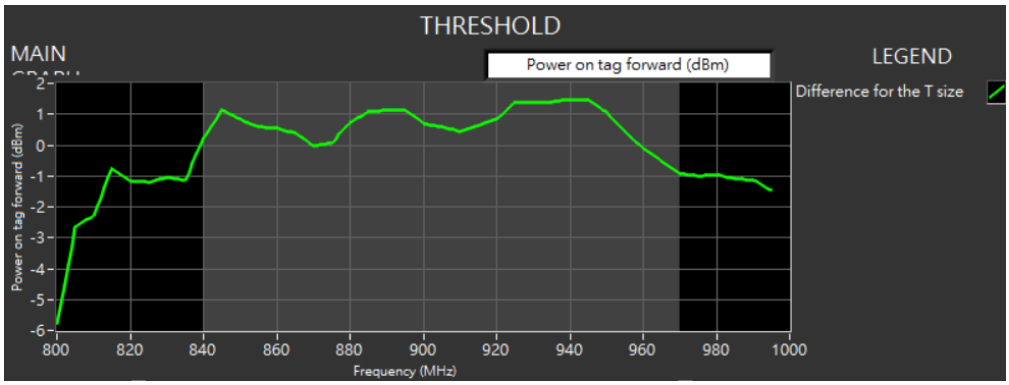


B. **Outside of the Chamber**, measurements taken at distances of 50cm and 30cm, respectively, for the T-sized metal plate case, showed a difference of ±1.25dBm within the frequency range of 840MHz to 970MHz. Outside this frequency range, greater differences were observed, which are more likely due to environmental interference.





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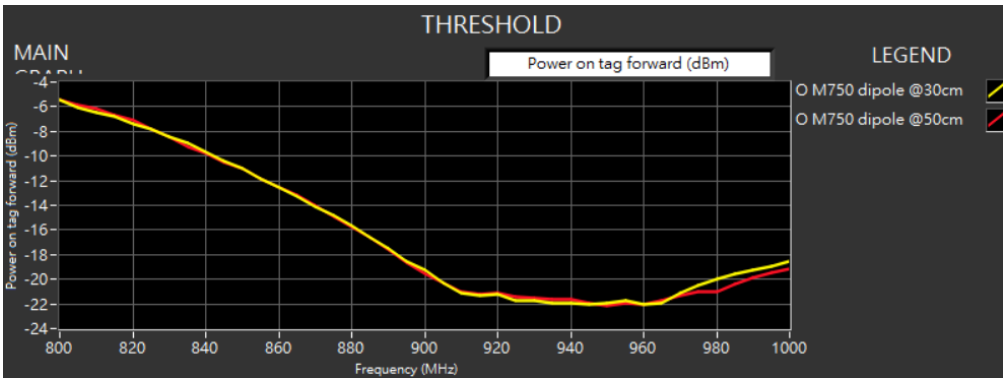
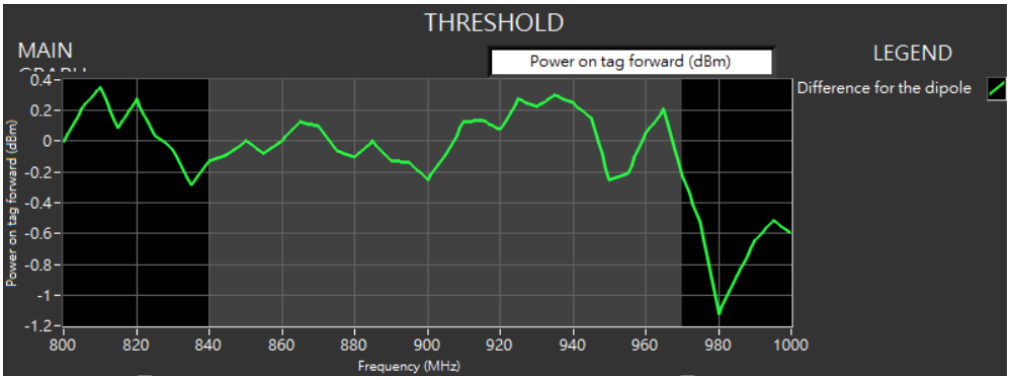
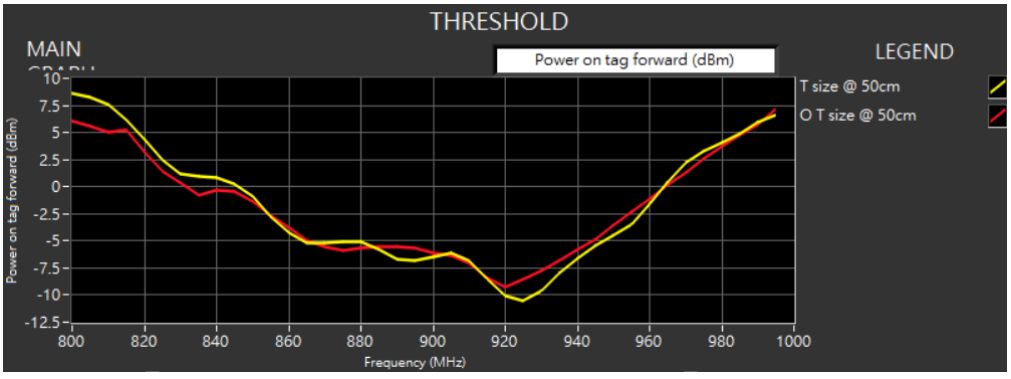
Again, let's measure the results for the normal dipole inlay under the same conditions. The difference of ±0.3dBm within the frequency range of 840MHz to 970MHz. Outside this frequency range, greater differences were observed, which are more likely due to environmental interference.



I use 'O' to represent "outside the chamber."



C. Finally, let's compare the measurement differences for the T-sized case at 50cm inside and outside the chamber. The results showed a difference of ±2.2dBm.



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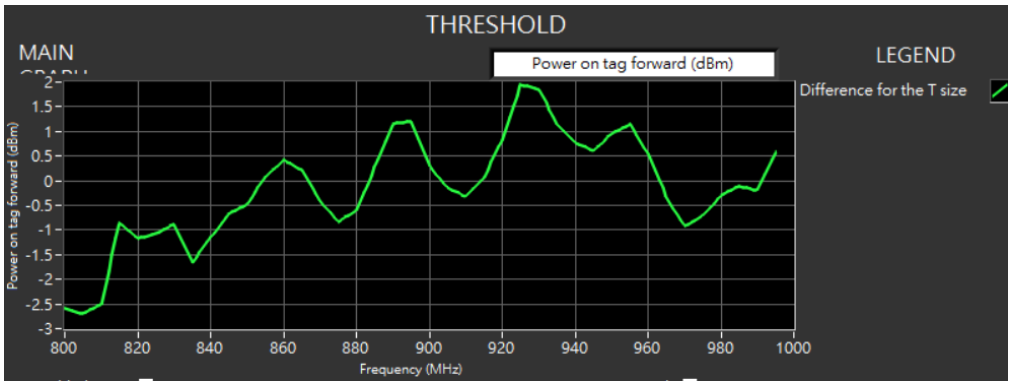
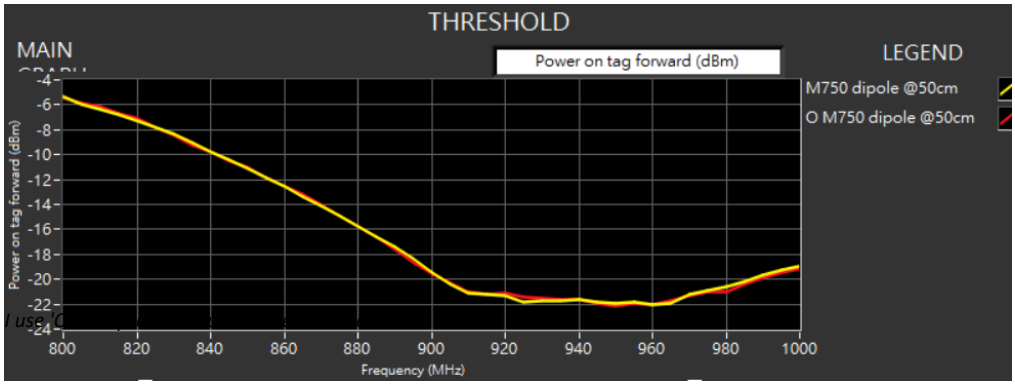
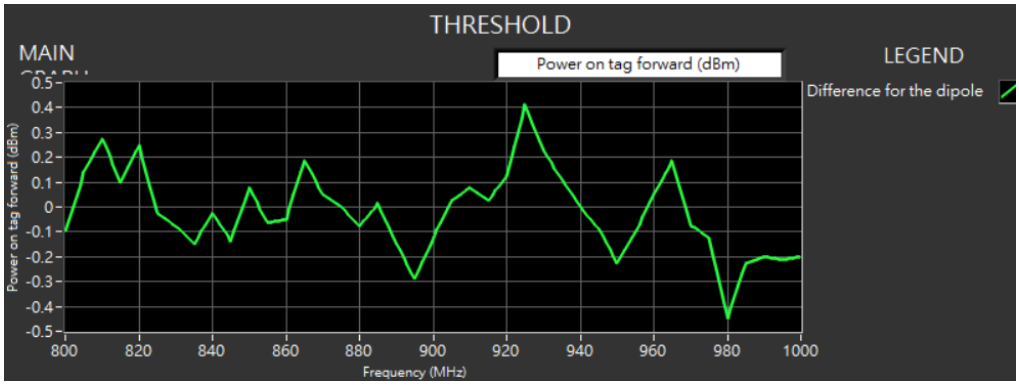


Let's measure the results for the normal dipole inlay under the same conditions once again. As expected, the difference is only ±0.5dBm, indicating that the results are more consistent and accurate.





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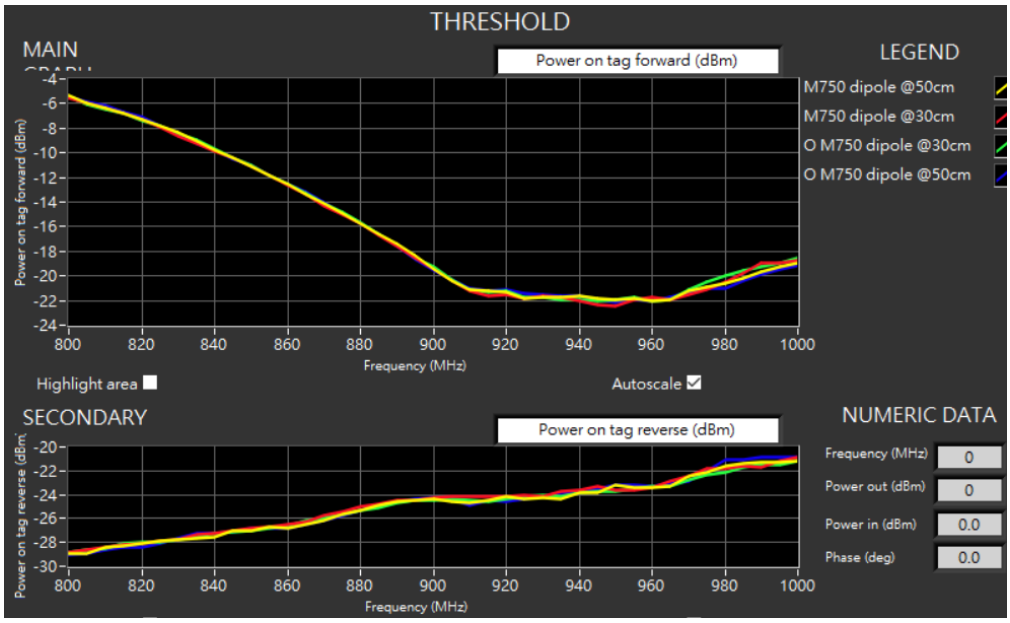
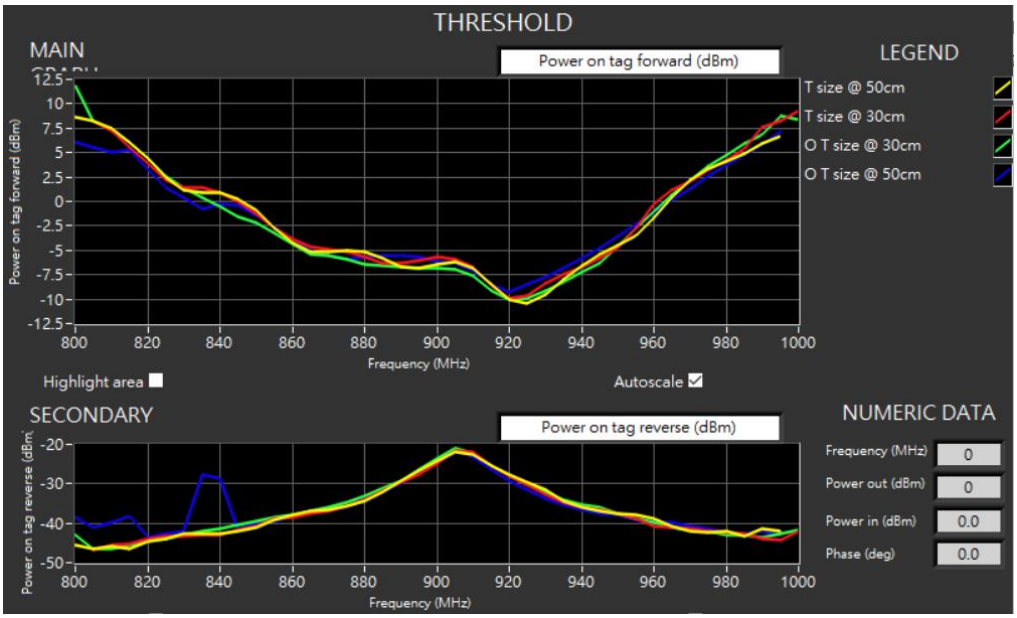
5 Conclusion

1. Generally, after performing the Voyantic reference tag's measured path loss, we obtain precise path loss measurements leading to more accurate results. This is evident from the measurements of the dipole inlay. As shown in the figure below, consistent results are obtained under different distances and environmental conditions.



2. Conversely, when examining the example of a metal tag on a metal plate, although the trend of the test curve appears consistent, it's notable that this application is highly sensitive to the testing environment, particularly outside the chamber, where it is more susceptible to external signal interference.



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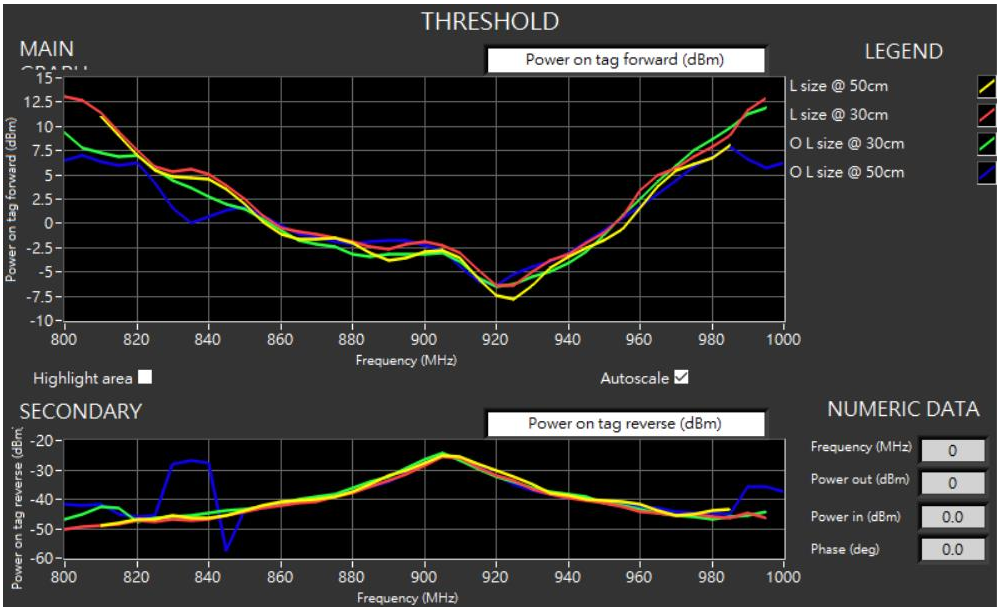
3. Additionally, I also observed that the differences in test results vary depending on the size of the metal plate used. One particularly notable example is with the L-size metal plate, where the differences in test results are more pronounced. The test results are as follows:



For conducting measurements of a metal tag on a metal plate, I would recommend:

1. Performing measurements in a spacious chamber, such as C50 chamber.
2. Conducting measured path loss procedure and verifying the difference between the actual result and default result of Voyantic reference tag is within ±0.5 dBm in the “Power on tag forward” unit.
3. Ensuring an adequate distance, as the metal tag on the metal plate can be considered a new test object, and its size will vary depending on the chosen metal plate dimensions. A testing distance of 50cm is considered ideal for far-field testing.

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