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Low Profile Flexible Metal Mountable UHF RFID Tag Antenna

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Introduction

- RFID technology is widespread nowadays in various applications (i.e. ticketing, library inventory, banking, supply chain, traceability of goods and logistics)
- In the last few years have been developed applications that imply tagging metallic objects, used on a large scale in supply chain, logistics and traceability of goods.
- To this end, more and more RFID tag manufacturers have chosen to develop tags that can be easily attached to metal objects.

Introduction

- In order to identify an object that consists or contain materials with adverse effect for the electromagnetic field, they were created tags with different shapes and sizes, but most of them having a rigid form.
- They were created also tags that can be placed on metallic objects with cylindrical or spherical shapes, known as flexible tags.
- These kinds of tags have large dimensions and can be attached only on big items.
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- In this paper the attention is focused on designing and testing a low profile metal mounting RFID tag that has small size and can be used for flexible surfaces.

Tag antenna design

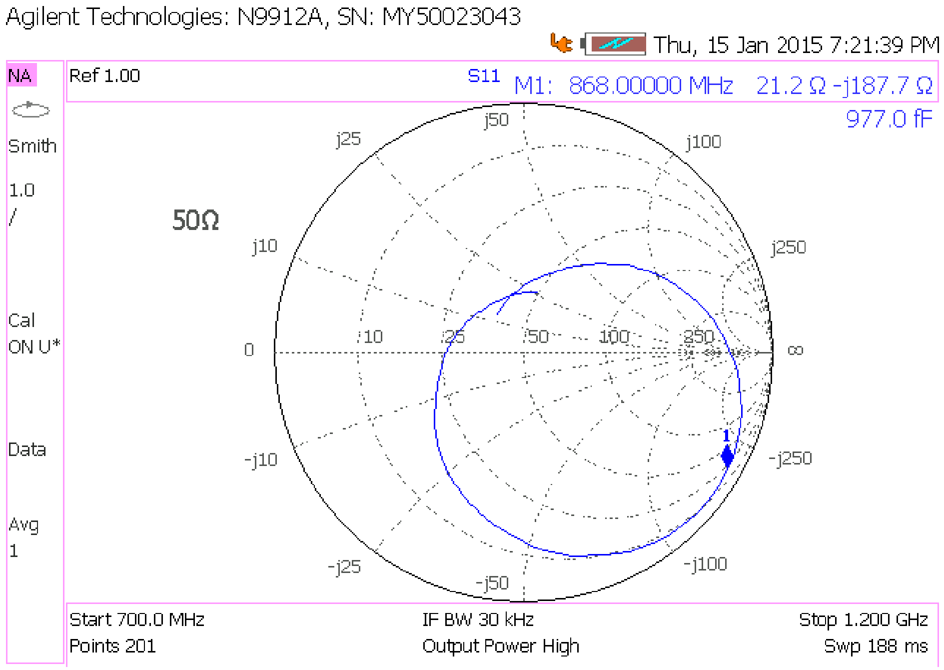
- Designed for HIGGS-4 EPC Gen2 chip from Alien Technology in SOT-323 package.
- Minimum activation power required is only -20.5dBm (~8μW) with $Z_{ic}=(20-j191)\Omega$ at $f_{res}=868MHz$.
- The maximum power transfer is possible if the chip impedance is equal with the conjugate value of the antenna impedance.
- In the real environment, when is used a soldered package for the chip, beside the chip impedance we can find some parasitic impedances that occurs from the soldered joints.

Tag antenna design

- The soldered RFID chip impedance is measured using a VNA.

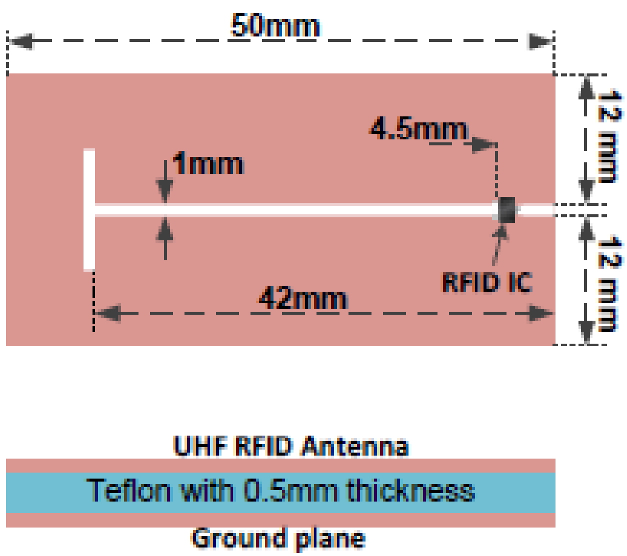
- The obtained value is $Z_{icm}=(21.2-j187)\Omega$

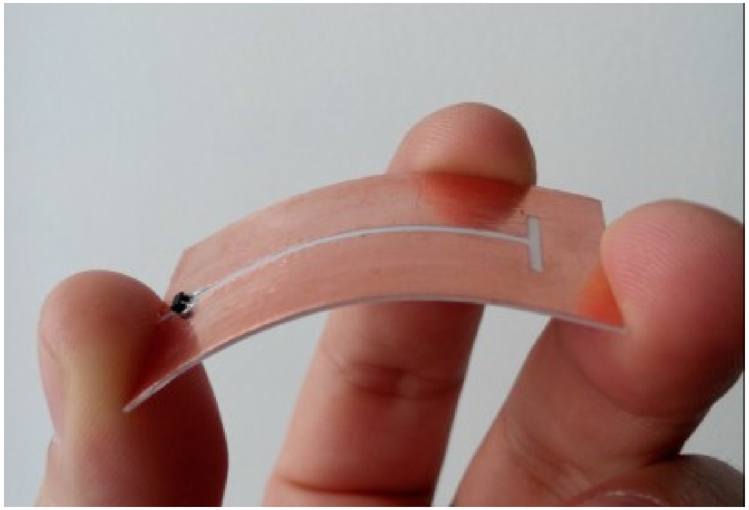
- For power transfer maximization the antenna impedance must be $Z_{ant}=(21.2+j187)\Omega$



Tag antenna design

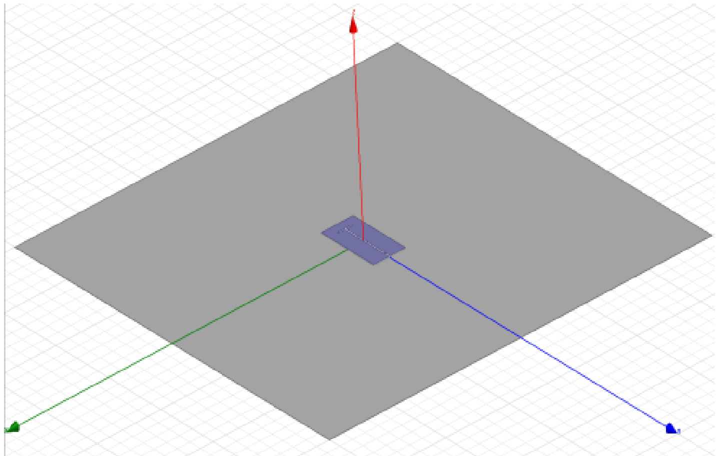
- The tag is fabricated using as dielectric Teflon, with a thickness of 0.5mm.
- For the conductive parts of the antenna is used adhesive copper tape with a thickness of 35μm.





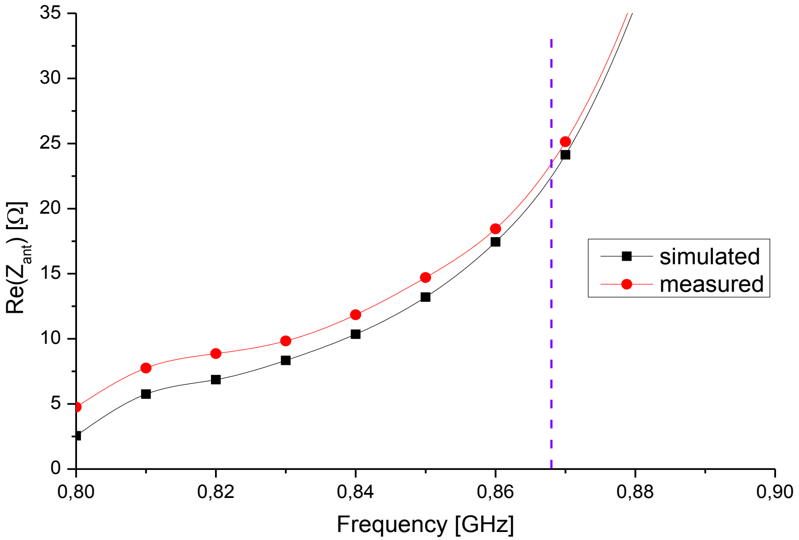
Simulated and experimental results

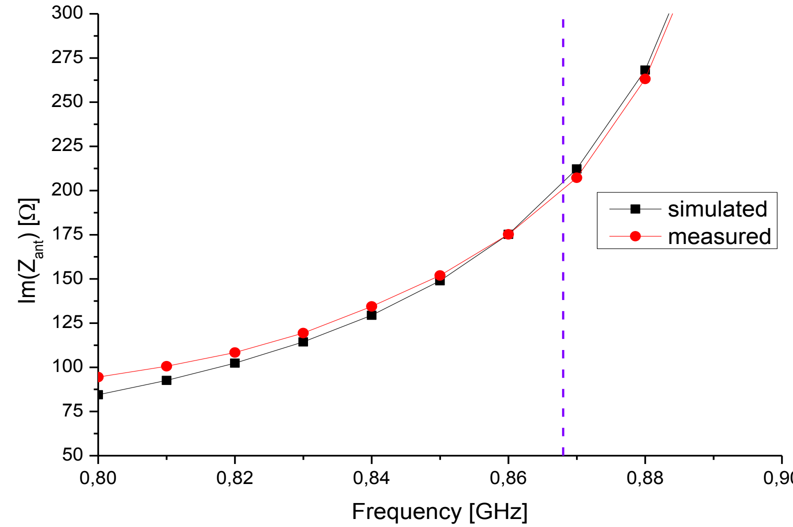
- The antenna model is simulated using an EM simulator. The simulation is performed with the antenna on a ground plane 400x400mm.
- Tuning the antenna is possible by simply move the feed point of the antenna.

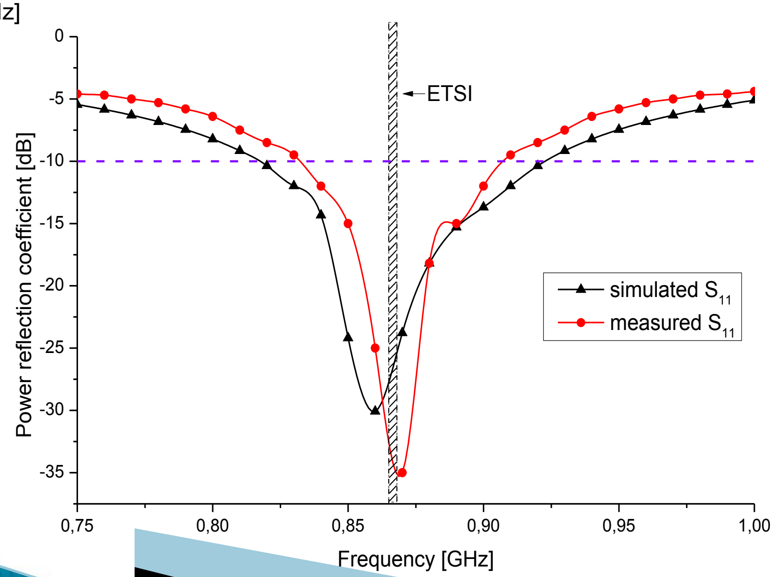


Distance of the feed point [mm]	$Re(Z_{11})$ [Ω]	$Im(Z_{11})$ [Ω]
1	26.2	208,4
3	25	203,1
5	23	190,6
7	22,7	263,2
9	27	230
11	21,4	185,7
13	19,2	186,4
15	18,3	183,1

Simulated and experimental results

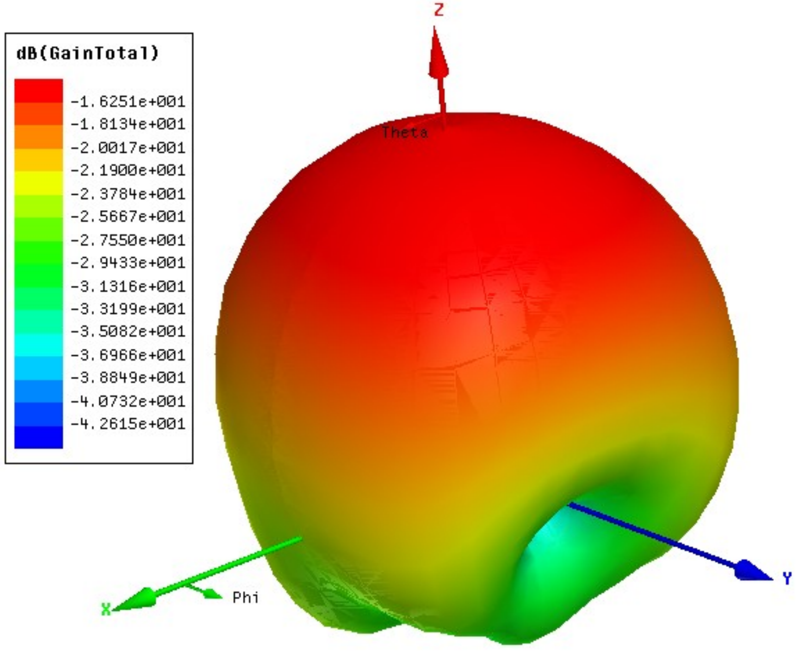






Simulated and experimental results

- The power transfer efficiency τ, is 0.9 which is a reasonable value taking into account that for maximum impedance matching τ is 1.
- The antenna gain for the tag will be obtained from the simulation, and for 868MHz we can achieve a maximum value of -16,25dB.
- The maximum reading distance on metal is 2.7m, with -20.5dBm as the chip activation power.



Conclusions

- In this paper is presented a low profile flexible antenna used for RFID tags.
- The obtained simulation can be verified with the experimental measurements.
- Using only 0.5mm thickness of the dielectric was achieved a reading distance of 2.7m and a bandwidth of 94MHz in the ETSI frequency band.
- This UHF RFID tag can be used for curved metal surface with good performances.

Thank you!

Questions?

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