Forum for Electromagnetic Research Methods and Application Technologies (FERMAT)

UHF RFID antenna for tagging metallic objects

Sergio López-Soriano and Josep Parrón

Universitat Autònoma de Barcelona, presented at EUCAP, 15 April 2015, Lisbon, Portugal

Abstract: Nowadays, the labeling of metal objects faces the challenge of getting a large read range while maintaining a reduced antenna size. This contribution presents a tag antenna design for identifying metal objects in the European UHF band (865-868 MHz). The antenna consists of a dipole mounted on a thin dielectric which is coupled to two shorted patches mounted on FR4 substrate. The overall dimensions of the tag are 73 mm x 25 mm x 3.2 mm. Full wave simulations show that this tag could attain a read range of 9.5 m when attached to a metal.

Keywords: Small antenna, long range, metallic surface, RFID tag antenna.

1. Lopez-Soriano, S.; Parron, J., " Small UHF RFID Tag Antenna for Metallic Objects," *Antennas and Propagation (EuCAP), 2015 9th European Conference on* , vol., no., 12-17 April 2015.

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Antenna Design

The antenna consists of a transmission line mounted on a thin dielectric (paper) which is coupled to two short-ended patches mounted on FR4 substrate.

Feeding element (**on Paper**)

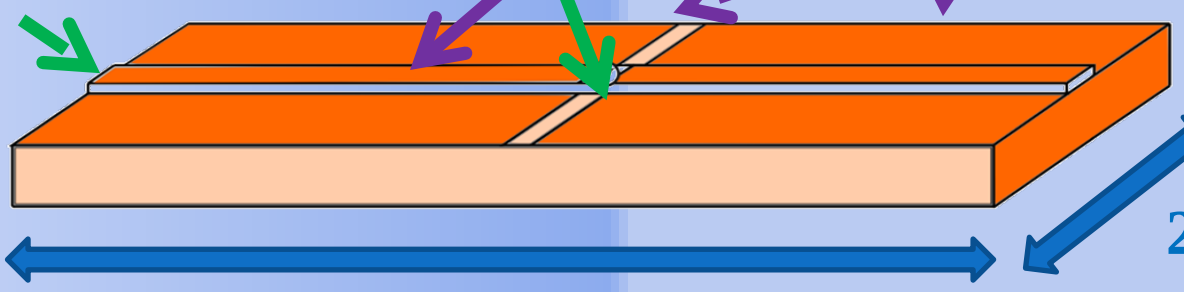
The **I.C.** is connected to the dipole.

The **transmission line** is coupled to the radiating element.

Radiating element (**on FR4**)

Two **short-ended** symmetrical **patches** separated by a gap.

The gap acts as a **radiating slot**.



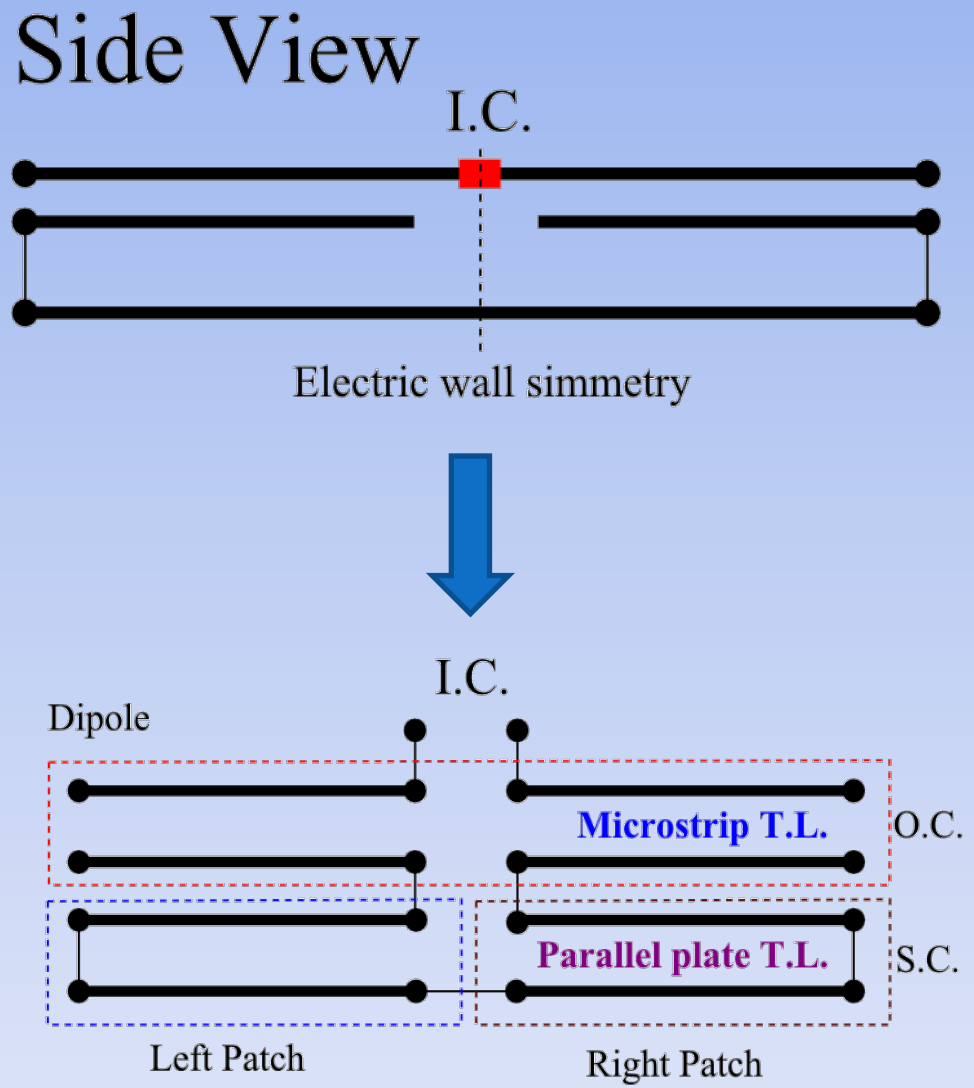
Paper
ε_r= 3.85
tanδ = 0.08
h=100 μm

FR4
ε_r = 4.2
tan = 0.02
h=3.1 mm

Transmission line model

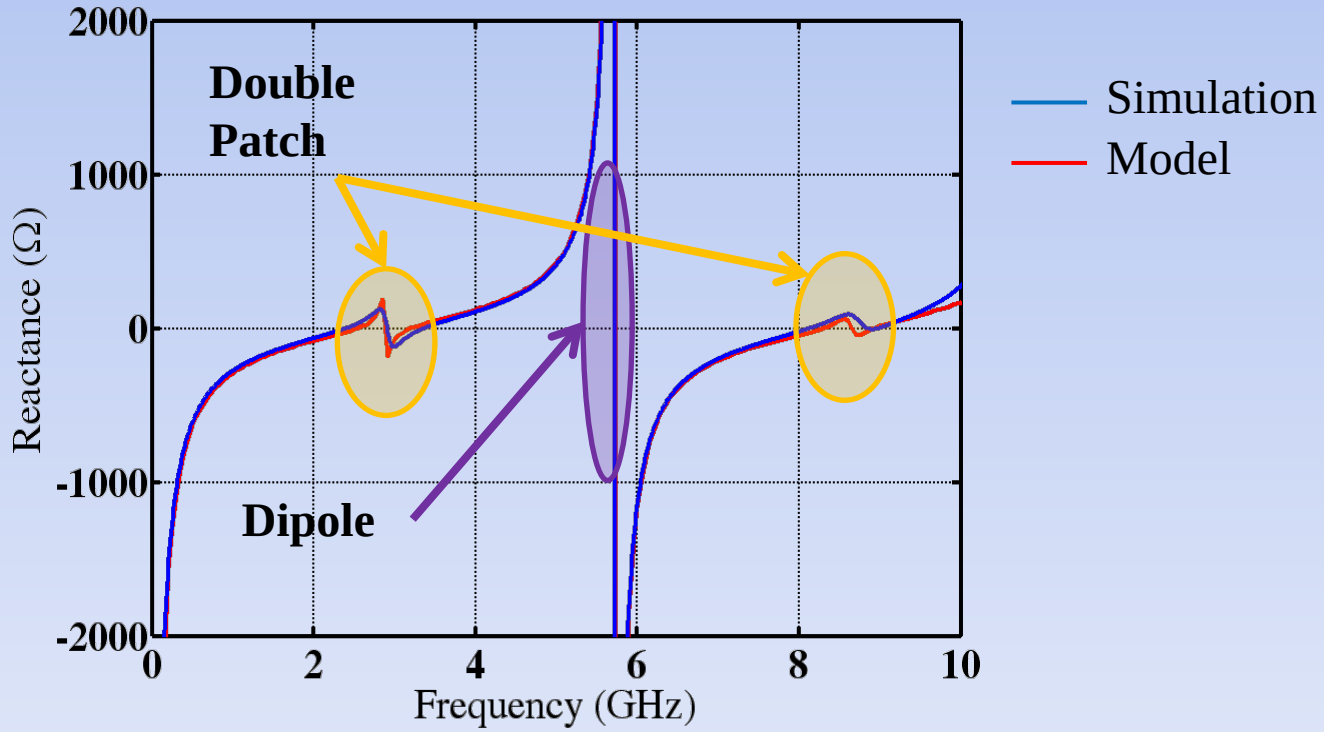
- The antenna can be seen as two transmission lines, one above the other.

- The top part is modelled as a microstrip transmission line and the bottom part is modelled as a parallel plate transmission line.



Validating the model

- In this case, both substrates are air. This produces a frequency shift to higher frequencies. Only FR4 losses are considered.
- The coupling between the two transmission lines is not an important effect. Thus, the model is quite accurate and can help to understand the operation principle of the structure.



Design Process

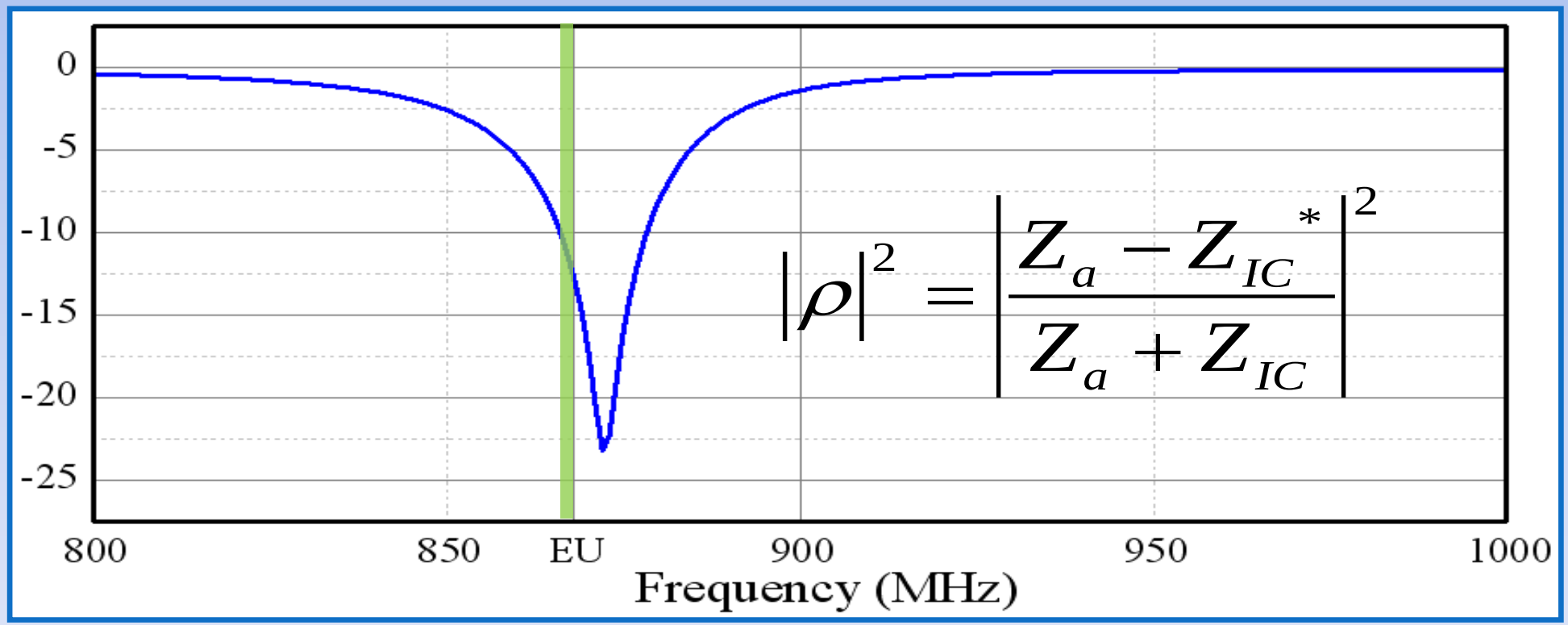
1. Determine the length and width of the patches to locate the first impedance resonance in the desired frequency range.

2. As usual, there is a trade off between requirements of size and gain. In this respect, the area of the patches and the gap between them must be tuned in order to optimize the gain while minimizing the size of the tag.

3. Finally, the impedance can be fine tuned modifying the transmission line dimensions to match different I.C. impedances.

Measured Power Reflection Coefficient (dB)

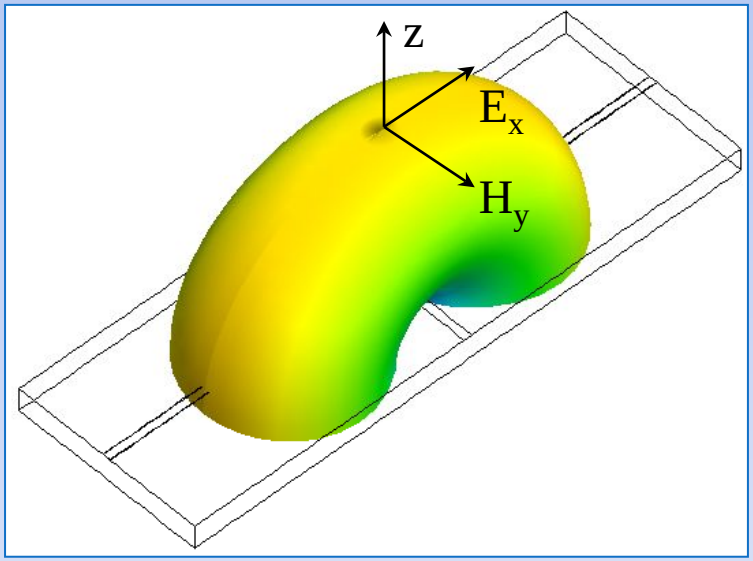
The antenna is matched to the Alien Higgs-3 chip (Z_{IC} = 30 – j211 Ω at 867 MHz).



Simulated Gain

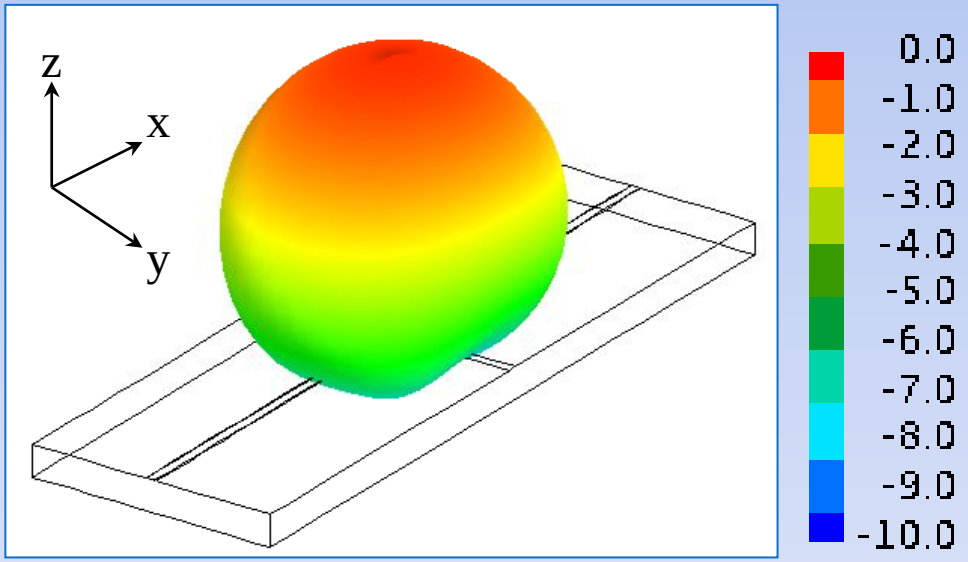
Infinite ground plane

the radiation pattern is the same as a magnetic dipole in the y direction



20 x 20 cm^2 ground plane

Maximum Gain (θ=0, φ=0) = -0.4 dB



Conclusions

- A simple transmission line model can be used in the design process.
- The fabrication procedure is easy and cheap.
- This tag attains a read range of 9.5 m which is larger than other tags of bigger size.