Methods for Impedance Matching in RFID Tags: A Review

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ABSTRACT
Radio frequency Identification (RFID) Tags basically consists of antenna as a radiating device and chip embedded as a storing device. The impedance match between two is of prime importance as it decides the overall performance of the tag. This paper discusses various methods to achieve the impedance matching by varying certain antenna parameters while designing it.

Keywords
RFID tag, Impedance Matching, Antenna designing

1. INTRODUCTION
The impedance match between an RFID IC and the RFID tag antenna is of critical importance in RFID tag design. A poor impedance match results in less power delivered to the RFID IC, resulting in reduced read range and overall poor Performance. [2] It is well know that the gain, input impedance and resonant frequency of the antenna can be significantly affected by nearby conducting and non conducting objects, and also affected by the substrate and super substrate properties [1] Impedance matching concept has been discuss in various papers covering wide areas of application as for safety glass applications[1], for implantation in live human brain tissue as the front end for a smart RFID [3], on metallic products in the steel industry [4], etc.

The goal of a tag antenna designer is to come up with an antenna that could increase the maximum detection range of the RFID system.[5] The gain of an RFID tag antenna is typically small and comparable to that of a dipole antenna which is about 2 dBi and there is not much flexibility to improve this gain value any further without losing the omni-directional property of the tag antenna or increasing the tag size beyond practical dimensions. [5].

Generally we design an antenna referring only single chip .The testing of same is done and the result analysis is carried out. But this makes the RFID tag manufacturers rely heavily on suppliers who supply only a certain type of the RFID chip. Furthermore, when the chip is upgraded to a new version, the RFID tag designers must redesign the tag, which is obviously undesirable. [4]

Following sections discuss the various methods which can be utilized for impedance matching and the table of comparison is shown describing the same for easier understanding.

2. CONCEPT OF IMPEDANCE MATCHING
The tag antenna input impedance should be a conjugate match to the microchip impedance at the minimum operational power to maximize the tag read range. The reflection coefficient when matching complex antenna input impedance to the complex chip impedance is given by[12]

$$\Gamma = Z_C - Z_a^* / Zc + Za$$

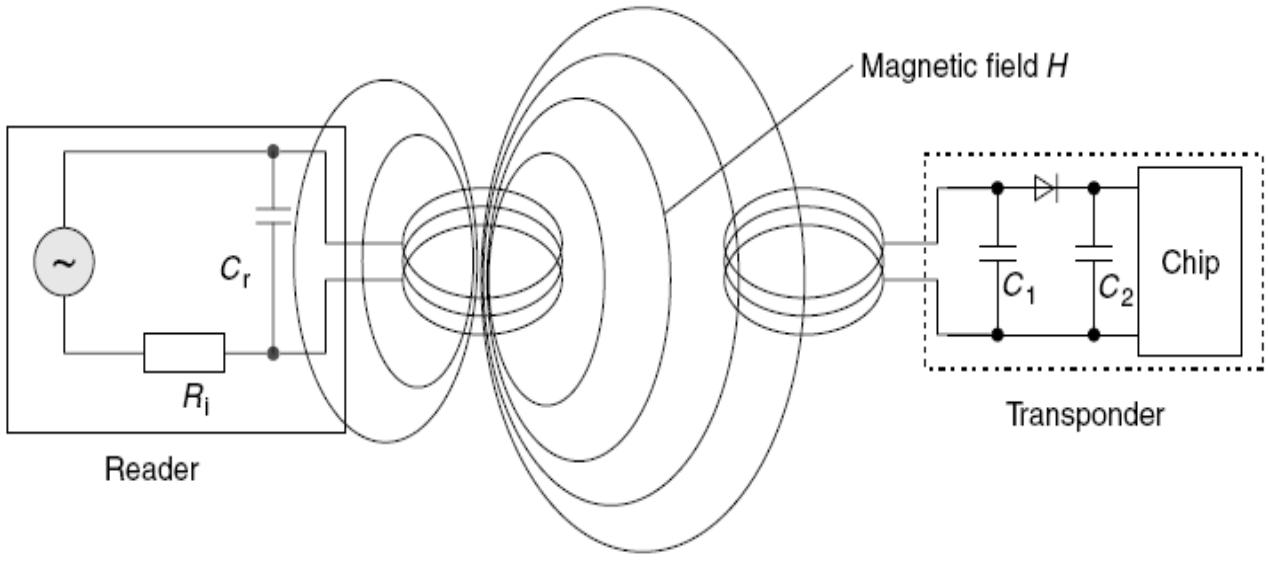

Fig.1 RFID working environment {ref.7}

3. DATA TRANSFER TRANSPONDER - READER

When an electrically coupled tag comes in an influence of in the interrogation zone of a reader, the input resistance of the transponder acts upon the resonant circuit of the reader via the coupling capacitance *Cr* active between the reader and transponder electrodes, damping the resonant circuit slightly. This damping can be switched between two values by switching a modulation resistor *R*mod in the transponder on and off. Switching the modulation resistor *R*mod on and off thereby generates an amplitude modulation of the voltage by the remote transponder. By switching the modulation resistor *R*mod on and off in time with data, this data can be transmitted to the reader. This procedure is called *load modulation.*

4. COMPARATIVE STUDY

Ref.1 **Methodology adopted:** Arm of dipole was cut into an L-slit to decrease the resonant length for the fixed size antenna and increase the input resistance.

Ref.2 **Methodology adopted:** T-MATCH ANALYTIC MODEL

Ref.3 **Methodology adopted:** The folded dipole dimensions are chosen to give anInductive input impedance that provides a good match to the capacitive load of the RFID tag when operating within brain tissue

Ref.4 **Methodology adopted:** The impedance of a slot antenna decreases toward zero when its feed point approaches the end of the slot, and this impedance varies progressively when the feed point is moved from the center point to the end of the slot.

Ref.8 **Methodology adopted:** An impedance matching method applicable to UHF-RFID tags mounted on optical discs, where the main radiating element is the disc metallic layer

Ref.9 **Methodology adopted:** Double Sided antenna is designed to achieve two objective of Impedance Matching and miniaturization of antenna Size

Ref.10 **Methodology adopted:** Multi pair Vias and Gap between two bowtie is used to adjust impendance Load Bars are used to control the operating mode of the frequency band

Ref.11 **Methodology adopted:** Length of the dipole (*L1+L3*) has significant influence on the resistance and the reactance of the antenna

5. CONCLUSION

Survey has been done in this paper regarding various techniques utilized for the impedance matching between RFID chip and tag antenna. We can conclude that the methodology used for impedance matching among the above mention techniques will depend upon the number of chips to be tested, the frequency range and the substrate used for designing an antenna. Based on the application one of the above mention methods can be utilized and the read range can be improved. Majority of the papers discussed above explains the impedance matching could be achieved by changing the antenna parameters except for the few which explains the methods such as by including the pairs of vias or by changing the feed points method which were very informative as a beginner in this field.

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