



# THE STUDY OF 2.45 GHZ RFID SYSTEM

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**Abstract:** In this paper we describe some tests for a 2.45 GHz RFID system. These tests were made both in the laboratory and outside. Through these tests we study the performance of 2.45 GHz RFID system in different work conditions.

**Key Words:** 2.45 GHz RFID tag, metal, car speed, read range.

## 1. INTRODUCTION

Radio Frequency Identification is a generic term for a set of technologies that use radio frequency (RF) to

communicate data. RFID has many advantages over visual markings—primary among them the ability to identify objects without the requirement of line of sight.

An RFID system [1] consists of tags, readers and a computer for storing and analyzing the data received from the reader. A tag is usually a memory device fitted on the object to be identified. It contains information to uniquely identify an object or a people. The reader is capable of generating, receiving, demodulating and deciphering RF signals.

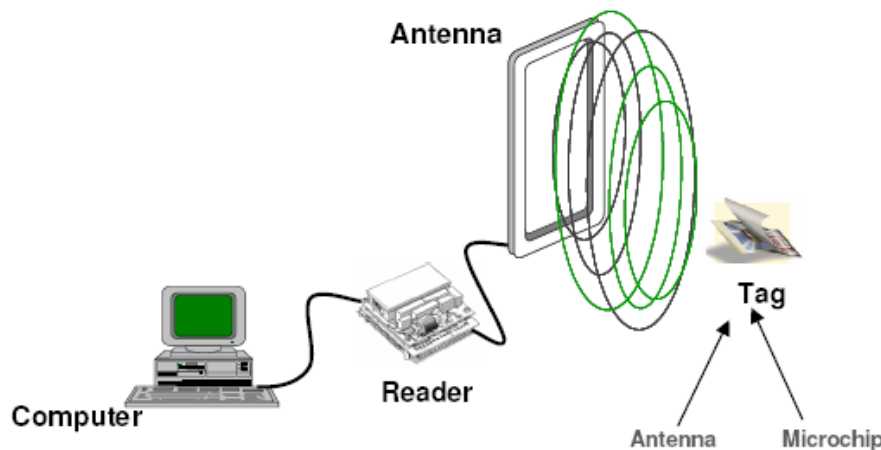


Fig. 1. The RFID system

RFID systems can operate at different frequencies depending on the applications:

- Low Frequency (125 KHz)
- High Frequency (13.56 MHz)
- Ultra High Frequency (860-960 MHz)
- Microwave (2.45 GHz)

Microwave RFID has many years of applications based primarily upon active tag applications. This technology is used for road-tolling, with factory automation, access control and logistics being other areas where this frequency is used.

Operation in the 2.4 GHz ISM band is attractive for a number of reasons:

- it is, effectively, a global allocation
- there is a limited amount of regulation ("light" constraints)
- access to this part of the spectrum is generally free
- it is ideally suited to high density fixed and mobile applications

In this article we describe some tests which illustrate the performances of 2.45 GHz RFID system. With these experimental tests we make obvious:

- the influence of environment factors to RFID system
- the influence of voltage battery tag to active range RFID system
- the influence of car speed to the read rate of tags.

## 2. THE MEASURE OF 2.45 GHZ RFID SYSTEM POWER EMISSION THE INFLUENCE OF BATTERY VOLTAGE TO RFID SYSTEM

The power emission of this system is very low (up to 1mW). This is remarkable in figure 2 that illustrates the power emission of RFID system for 20 readied tags. It was obtained the peak at 53.2 dBm.

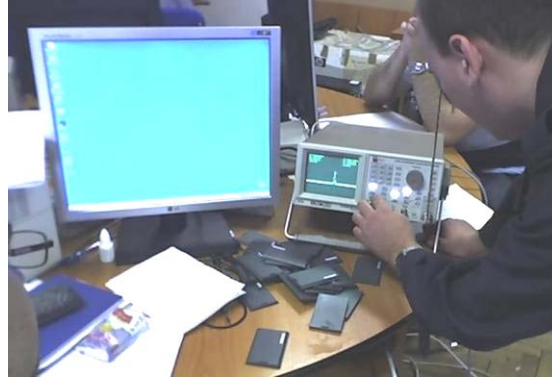
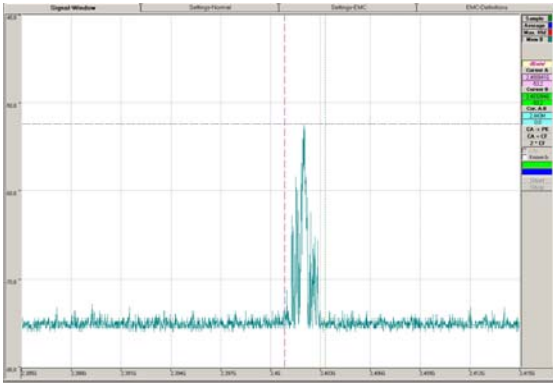


Fig. 2. The power supply of tags

For the study of the influence of battery voltage to RFID system we eliminate the case of tag. After this, we supply the tag from an adjustable power supply source. Because it is necessary to move the tag at different distances from reader, the source is supplied from an UPC. Serially connected with the tag is an ammeter that read the tag current (figure 3).

From this test issued the next conclusions:

- when the voltage is reduced until  $1.6 \div 1.7V$ , the tag is identified at a maximum distance. Below to this voltage, the tag isn't identified
- the tag current is of the order of  $190 \mu A$  (both at reading and at pause)

This testing is necessary for the application because show that the tag work perfect if the battery is discharged. Also, it's possible to make cases with high power battery for the tags.

### 3. THE POSSIBILITY TO IDENTIFY A TAG THAT HAS A HIGH SPEED

Three different tags are placed on the windscreen in different places like in figure 3a. Also, the reader is placed in three different places: at 10m, 5m and 0.7m from roadside (figure 4b).

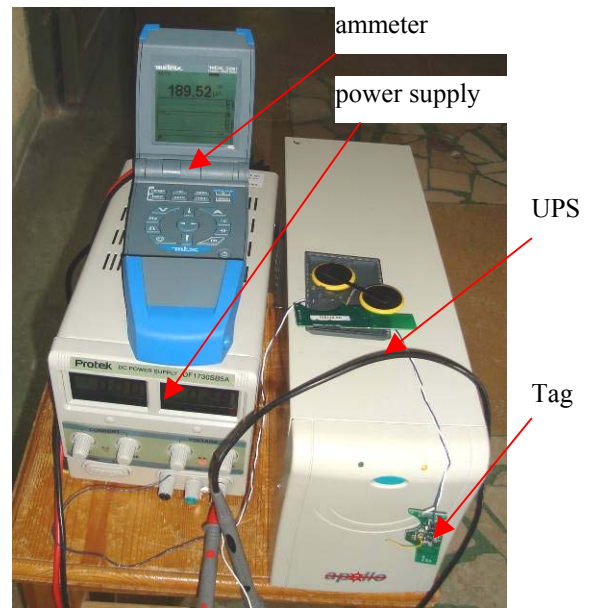
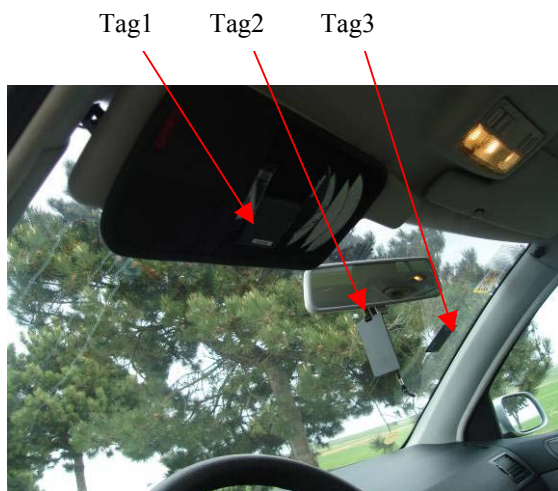


Fig. 3. The logistic for the test with battery



a



b

Fig. 4. The arrangement for the test with car

The car passes in front of reader with 40, 60, 80 respectively 100 Km/h. We don't make test at speed over 100 km/h because in a crossroad a conveyance not runs after this speed [3].

The follow conclusions are issued after the test:

- for the detect of the tag that passes with speed up to 100 km/h it's not significant the speed, but it is necessary to know the moment when the tag is identified (rather the distance between tag and reader when the identifying is started)
- between the three tags placed in different places the best detecting is for tag 3 (figure 4 a). So, it is very important the relative position between the reader and the tag.

#### 4. THE MEASURE OF MAXIMUM ACTIVE RANGE OF SYSTEM AND THE INFLUENCE OF DIFFERENT MATERIALS

Another test is to determine the influence of different materials, which the tags are fixed. Microwave communication range between 2 and 80 m can be adjustable by attenuator. A tag that is not glued on any material is detected at maximum 50 m.

- the active range is reduced with over 50% (~20 m) when the tag is glued on the piece of metal
- the attachment of a tag on a water PET (figure 5) has the next effects:
  - if the tag is parallel with the reader and it is orientate to reader, the active range is reduced with 30% (~20 m)

if the tag make with the plane of reader an angle by 90°, the active range is reduced with over 50% (~20 m)

Tag



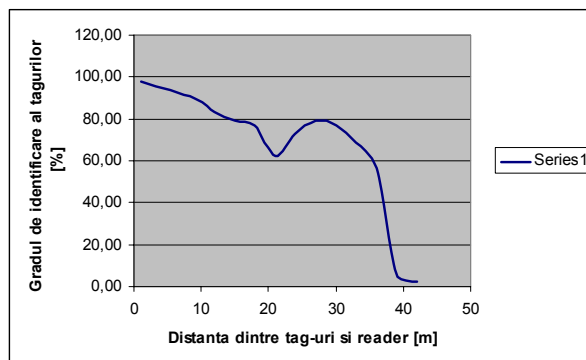
Fig. 5. The tag on water PET

#### 5. THE POSSIBILITY TO SIMULTANEOUS DETECTED MANY TAGS

For the study of the possibility to simultaneous detected many tags, we use two boxes, each with 24 tags (figure 6.a.).



a)



b)

Fig. 6. The identification rate of tags

The figure 6 b shows the number of identified tags in accordance with the distance from reader. We can see that the tags are identified in a percent by over 80% for a read range up to 15 m.

#### 6. CONCLUSIONS

In this paper are presented some tests for the study of influences of a part of these factors like: battery voltage, metal, water, nearby tag, and speed car.

From the results obtained with these tests we could observe:

- for the detect of the tag that passes with speed up to 100 km/h it's not significant the speed, but it is necessary to know the moment when the tag is identified
- when the voltage of battery is reduced until 1.6÷1.7V, the tag is identified at a maximum distance. Below to this voltage, the tag isn't identified
- the active range is reduced with over 50% (~20 m) when the tag is glued on the piece of metal
- the attachment of a tag on a water PET causes the considerable decreasing of read range
- it is very important the relative position between the reader and the tag

## 7. REFERENCES

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