

Experimental Determinations of Electromagnetic Radiations Issued by a Wireless Device

Ph.D.eng. Ardeleanu Mircea-Emilian
Electrical Engineering Faculty
University of Craiova
107, B-dul Decebal
Romania

mircea_emilian@yahoo.com

eng. Nicoleanu Paul
High Voltage Division

National Institute for Research Development and Testing in Electrical Engineering (ICMET)-
Craiova

118A, B-dul Decebal
Romania

cem@icmet.ro

Abstract: - The development in the last decades of the mobile telephony and, in general, of the wireless devices as a communication means and data transfer lead to theoretical and experimental studies and researches concerning the exposure of electromagnetic emissions. Inside the office buildings, houses, it is used more often the wireless access to the internet of the accounting technique (computer networks, laptops, tablets, etc.) by using routers. In this article there are presented some experimental results concerning the determination of the electromagnetic field issued by a low power router, for common use, mainly used in houses, offices. The determinations have been performed in the specialty laboratory of ICMET Craiova. The results obtained for the situation studied have shown dangerous values of electromagnetic field emissions.

Key-Words: - electromagnetical field, router, wireless devices, electromagnetical emission, exposure to electromagnetic radiation, electrical field strength, precision dipole antenna.

1 Introduction

The development of the mobile communications equipment, fast and permanent movement of the information on the internet and other social networks lead to a strong growth and improvement of the wireless devices of communications and data transmission.

These things lead to the achievement of some theoretical studies and researches, but more practical, whereat there were participated interdisciplinary teams concerning the exposure degree at the electromagnetical emissions.

The use of wireless devices for communications, through the electromagnetical field which they emit, can form for a medium or long period of time, a risk factor for people's health that work, permanent or temporary near them.

Thus, the study and supervision of the exposure degree to the electromagnetical emission.

This article aims to present some experimental determinations concerning the electromagnetical

field issued by a AC750 Dual Band router, 750 Mbps, to the frequency of 2,4 GHz used for the wireless connection to the internet in an apartment, house, offices, etc.

The measurements were performed in the specialty laboratory of ICMET Craiova.

2.Aspects regarding the exposure to electromagnetical emissions.

As stated earlier, the fast and powerful development of the wireless devices of telecommunications and data transmission raised in front of the specialists from various activity fields (chemistry, physics, medicine, electrical and electronical engineering, telecommunications, etc.) a very essential issue for the human being namely of the biological risk to exposures to the electromagnetical emissions.

This issue is based on the known electrotechnical phenomenon, namely that electromagnetic field emission is a permanent presence of energy transfer,

knowing that theoretically any physical body at a temperature other than 0°K can emit electromagnetic emissions [1].

A relevant aspect of this and highlighted in various studies have shown that an effect of subjecting the human body to electromagnetic radiation is the increase in the temperature of the human body.

The human body, through its complex structure, through the internal mechanisms it possesses, has the power to react to certain external stimuli by activating thermoregulatory processes of temperature due to electromagnetic radiation.

It has been shown that random exposure to electromagnetic radiation with values within acceptable limits can produce a very slight increase in human body temperature by 0.1 °C.

Studies, experiments, analyzes and research on the influence of radiation.

Electromagnetic effects on the human body also revealed the possibility of "non-thermal" effects.

Thus, it is possible for lower electromagnetic field strengths than those producing thermal effects to show some "non-thermal" effects that can be detected, affecting inter alia immune system activity [1].

In this respect, young people (children, adolescents) whose body is in the process of developing, training and consolidation are most exposed to such risks.

3.Experimental study of the electromagnetical emissions

3.1 Equipments used

The experimental study aimed primarily at determining the electromagnetic emissions of a router used for wireless internet connection.

It was analyzed a AC 750 Dual Band Router (2.4 GHZ, 5 GHz) used in small spaces, offices, apartments.

In fig.1 it's presented the equipment studied.



Fig.1 AC 750 Dual Band Router

The experimental determinations were carried out in the specialized laboratory of ICMET Craiova

using special measuring equipment for industrial use.

For the measurement of the electromagnetic field emission (electrical field strength), a PCD- 8250 precision dipole antenna produced by ARC SEIBERSDORF was used.

In fig.2 [2] it's presented this antenna that has emission elements in the conical construction.

The frequency band is between 80 Mhz and 3 Ghz.

It can measure electromagnetical fields with intensity of the electric field up to 100 V/m operating at an ambient temperature between 50° C and 400° C.

It is equipped with an automatic rotation device that provides measurements in all three axes.



Fig.2 PCD- 8250 precision dipole antenna

The Spectrum Analyzer used was an Anritsu Spectrum Master MS 2711D (Fig. 3).

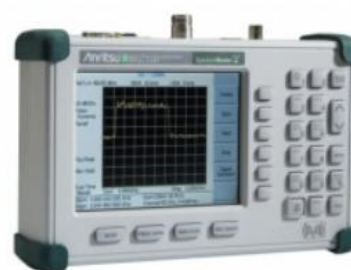


Fig.3 Anritsu Spectrum Master MS 2711D[3]

In order to determine the magnetic field emission issued by the router studied, it was performed the experimental assembly of fig. 4.

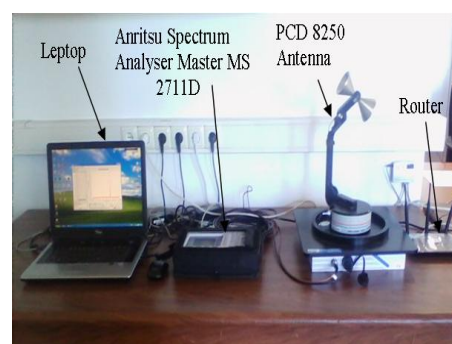
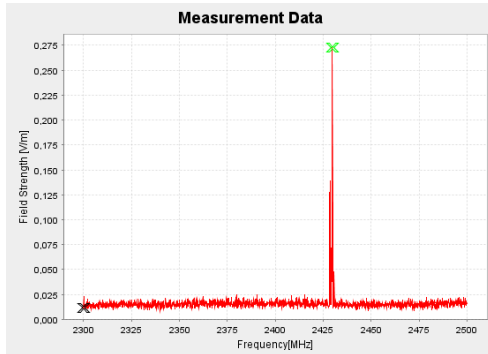


Fig.4 The experimental assembly

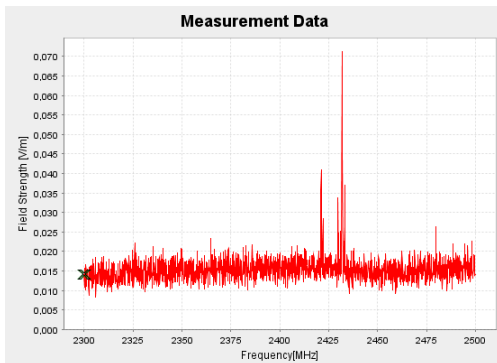
3.2 Experimental results

In the fig 5a and 5b are presented the results of the electromagnetical field measurements, obtained for the router studied, connected to the internet network but without that during the measurements the data transfer should perform to any laptop or other equipments.

The experimental determinations were made for a distance between the antenna and the studied equipment of 50 cm (fig. 5a) and 70 cm respectively (fig.5b).



a)



b)

Fig.5 Results of the electromagnetical field measurements

a) at 50 cm. ; b) at 70 cm

The results of the experimental data processing are presented in Table 1

Table 1

Distance [cm]	E [V/m]	H [A/m]	B [T]	dBuV/m	dBuA/m	W/m ²
50	0.2727	7.256·10 ⁻⁴	9.135·10 ⁻¹⁰	108.71	57.21	1.973·10 ⁻⁴
70	0.0712	1.894·10 ⁻⁴	2.385·10 ⁻¹⁰	97.05	45.55	1.345·10 ⁻⁵

3.3 Analysis of the experimental data

From Fig. 5a and 5b, it is observed that the maximum field strength is achieved at the 2.43 GHz frequency, close to the 2.5 GHz router's construction frequency.

The electrical and magnetic magnitude values presented in Table 1 indicate low and not dangerous values for the electrical field strength, magnetic induction and magnetic field strength.

In Table 2, respectively Table 3 [5], there are presented the risk levels of the electromagnetic field sizes for personnel permanently working in the environment with electromagnetic emission or for personnel accidentally reaching the environment with electromagnetic emission.

As expected, the field strength decreases with the distance, and although the values determined for the field strength are small, the values measured at a distance of 50 cm are approximately four times greater than those determined at a distance of 70 cm.

Table 2

Frequency range	E-field strength (V m ⁻¹)	H-field strength (A m ⁻¹)	B-field (μT)	Equivalent plane wave power density S _{av} (W m ⁻²)
up to 1 Hz	—	1.63 × 10 ¹	2 × 10 ¹	—
1-8 Hz	20,000	1.63 × 10 ¹ f ²	2 × 10 ¹ f ²	—
8-25 Hz	20,000	2 × 10 ¹ f ²	2.5 × 10 ¹ f ²	—
0.025-0.82 kHz	500f	20f	25f	—
0.82-65 kHz	610	24.4	30.7	—
0.065-1 MHz	610	1.6f	2.0f	—
1-10 MHz	610f	1.6f	2.0f	—
10-400 MHz	61	0.16	0.2	10
400-2,000 MHz	3f ^{1/2}	0.008f ^{1/2}	0.01f ^{1/2}	f/40
2-300 GHz	137	0.36	0.45	50

Table 3

Frequency range	E-field strength (V m ⁻¹)	H-field strength (A m ⁻¹)	B-field (μT)	Equivalent plane wave power density S _{av} (W m ⁻²)
up to 1 Hz	—	3.2 × 10 ¹	4 × 10 ¹	—
1-8 Hz	10,000	3.2 × 10 ¹ f ²	4 × 10 ¹ f ²	—
8-25 Hz	10,000	4,000f ²	5,000f ²	—
0.025-0.8 kHz	250f	4f	5f	—
0.8-3 kHz	250f	5	6.25	—
3-150 kHz	87	5	6.25	—
0.15-1 MHz	87	0.73f	0.92f	—
1-10 MHz	87f ^{1/2}	0.73f	0.92f	—
10-400 MHz	28	0.073	0.092	2
400-2,000 MHz	1.37f ^{1/2}	0.0037f ^{1/2}	0.0046f ^{1/2}	f/200
2-300 GHz	61	0.16	0.20	10

In the case of a complex analysis of the determination of the electromagnetic emission

produced by a wireless transmission equipment within a local network, several situations and variables have to be considered, such as: number of workstations (connected users); type of information transmitted (data, video); the distance to the access point and the distance from the working point; position on wireless equipment; traffic direction (upload or download); transfer rate etc.

Practical experiments to determine exposure to electromagnetic emission from wireless data transmission devices have shown that increasing the data transfer rate does not necessarily require an increase in the field strength, and the intensity of the magnetic field may be influenced by the conditions of conveyance and data transfer (upload or download) [6].

4. Conclusion

The fast and strong development of wireless telecommunication and data transmission devices in the past few years and further growth prospects have posed a lot of technical problems but also the nature of studying the effects of the prelingate or accidental exposure of human beings to electromagnetic emission.

Interdisciplinary studies and researches have shown that prolonged exposure to electromagnetic radiation emitted by wireless devices can cause thermal effects (increase of temperature) on the human body but also non-thermal effects.

In the study, analysis and measurement of the electromagnetic field parameters emitted by a wireless device used for data transfer (internet connection) many theoretical and practical aspects have to be taken into account, taking into account many parameters that can influence the measured values that can be remembered: number of workstations; type of information transmitted (data, video); the distance to the access point and the distance from the working point; position on wireless equipment; traffic direction (upload or download); transfer rate etc.

This paper presented the results of the measurements made for an AC750 Dual Band, 750 Mbps, 2.4 GHz router frequently used to connect to the Internet in houses, offices.

The measurements were made in the specialized laboratory of ICMET Craiova and special

equipment (precision dipole antenna PCD-8250, Anritsu Spectrum Master MS 2711D) was used.

In this first stage, the measurements targeted the simplest situation, namely the router connected to the internet but not transferring data.

The results obtained and presented in fig. 5 and table 1 showed for this situation small and non-hazardous values of the electromagnetic field sizes.

The studies, comparative analyses and future measurements will take into account several operational parameters and situations presented in the article, which may influence the exposure to electromagnetic emission, issued by wireless devices (routers) on the human body

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