

Measurements Of High Frequency Electromagnetic Waves In Center Of Mus

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Abstract: All electrically powered devices cause electromagnetic wave exposure on human body and we use them nearly every moment in a day. Mobile phones, computers, televisions, hair dryers, lighting systems, etc. they all use electricity and naturally radiate electromagnetic waves. Effects of electromagnetic waves are not clear but international organizations define limit values depending on epidemiological studies in this field. In this study we measure high frequency electromagnetic waves in city center of Mus. Measurements are made at mobile phone frequencies and results compared with limit values. All measurement techniques and limit values are appropriate with Information and Communication Technologies Authority (ICTA) standards. Measurement points are selected according to population density in city center.

Keywords: Electromagnetic Field, Mobile Phone, Base Station, Electric Field Measurement, Electromagnetic Pollution.

1. Introduction

Electromagnetic waves were created by motion of electric charges. They have two main component; electric field and magnetic field. Electric field values are generally shown in volt per meter unit and magnetic field values generally shown in Tesla unit.[1]

Communication systems often use electromagnetic waves for data transfer. Each frequency band of electromagnetic spectrum has its own specification and characteristic.[2]

As it shown in Fig. 1 communication systems use radio-frequency band of electromagnetic spectrum. Their frequency is less than 300 GHz. Mobile phones, satellites, radar systems, wireless modems, TV and radio broadcasts use radio-frequency band of electromagnetic spectrum. [3]

All electrically powered devices radiate electromagnetic waves. Additionally, some communication devices uses electromagnetic waves for their purpose and increases electromagnetic waves they were radiated.

World Health Organization (WHO) researches effects of electromagnetic waves in last three decades. There are a lot of studies about health effect of electromagnetic waves. But most of them could not show health effect of electromagnetic waves clearly. International Commission on Non-Ionizing Radiation Protection (ICNIRP) determines limit values for non-ionizing electromagnetic waves. In Table I, ICNIRP limit values are shown.[4-5]

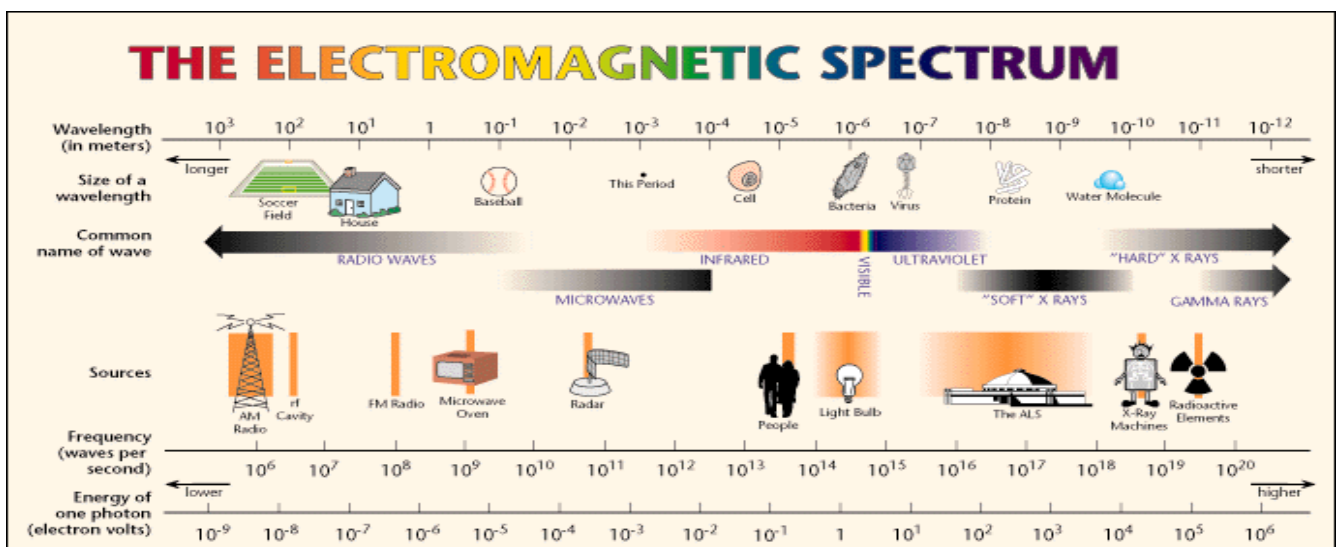


Figure 1. Electromagnetic spectrum [7]

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Table 1. ICNIRP limit values

Frequency Range	E-Field Strength (V.m-1)	H-Field Strength (A.m-1)
Up to 1 Hz	-	3.2×10^4
1-8 Hz	10000	$3.2 \times 10^4/f$
8-25 Hz	10000	$4000/f$
25 Hz - 3 kHz	$250/f$	5
3-150 kHz	87	5
0.15-1 MHz	87	$0.73/f$
1-10 MHz	$87/f^{0.5}$	$0.73/f$
10-400 MHz	28	0.073
400-2000 MHz	$1.375/f^{0.5}$	$0.0037/f^{0.5}$
2-300 GHz	61	0.16

In Table I, f values indicates frequency values.

Limit values of electric field for mobile phone frequencies are more than 40 volts per meter. In Turkey this value is 9.15 volts per meter, so Turkey applies more than four times lowered limit values on non-ionizing radiation protection.[4]

2. Materials and Methods

In this paper we measured electric field of mobile phone frequencies (GSM900, GSM1800, UMTS, LTE) in city center of Mus. Measurements are made in main streets of the city. With GPS data we showed measurement results on the map.

2.1. Measurement Device and Probe

We used Wavecontrol SMP2 electromagnetic radiation measurement device. Device specifications are shown below;

- 1) 1Hz to 18 GHz Broadband Measurements: With RMS and Field probes can measure up to 18 GHz.
- 2) Spectrum Analysis: With a specific probe, spectrum analysis 1 Hz to 400 kHz.
- 3) Weighted Peak Method (WPM): Real time comparison in percentage with selected limits.
- 4) Assessments According to European Directive 2013/35/EU: In accordance with international standards such as ICNIRP, IEC, EN, IEEE, etc.
- 5) GPS Support: GPS module integrated in the instrument.
- 6) Connection Options: USB and Fibre Optic connection supported by a PC software.

As measurement probe we used WPT mobile frequency probe. This probe measures only total electric field value of 2G, 3G and 4G frequencies. WPT probe measures only frequencies for GSM800, GSM900, GSM1800, UMTS2100 and LTE2600. But for example 4.5G frequencies in Turkey provided by mobile communication operators are 800 MHz, 1800 MHz and 2600 MHz. WPT mobile frequency measurement probe can measure all of these frequency bands. SMP2 electromagnetic radiation measurement device with WPT probe only measures total electric field strength of the all mobile phone communication frequencies and saves measurement data. Measurement device and probe are shown in Fig. 2.

2.2. Measurement Mode and Standards

Measurements are made in mobile measurement type. Measurement device was put on a car and while car was travelling 30 km/h fixed speed, device measured electric field of the medium. Measurement instances are taken in every 5 seconds. Measurement results were shown on a map according to GPS data and field strength.



Figure 2. SMP2 electromagnetic radiation measurement device and WPT probe.

3. Measurement Results

According to measurement results;

- Maximum measurement value is 5.85 V/m and measured in middle of the Ataturk Boulevard.
- Average measurement value is 1.098 V/m during the whole measurement
- Comparison of electric field strength values in main streets from the highest to the lowest: Ataturk Boulevard, Istasyon Street and Cumhuriyet Street.

Measurement results are shown in Fig. 3. Green points show 0-2 V/m electric field strength value. Yellow points show 2-4 V/m electric field strength value and Red points show 4-6 V/m electric field strength value.

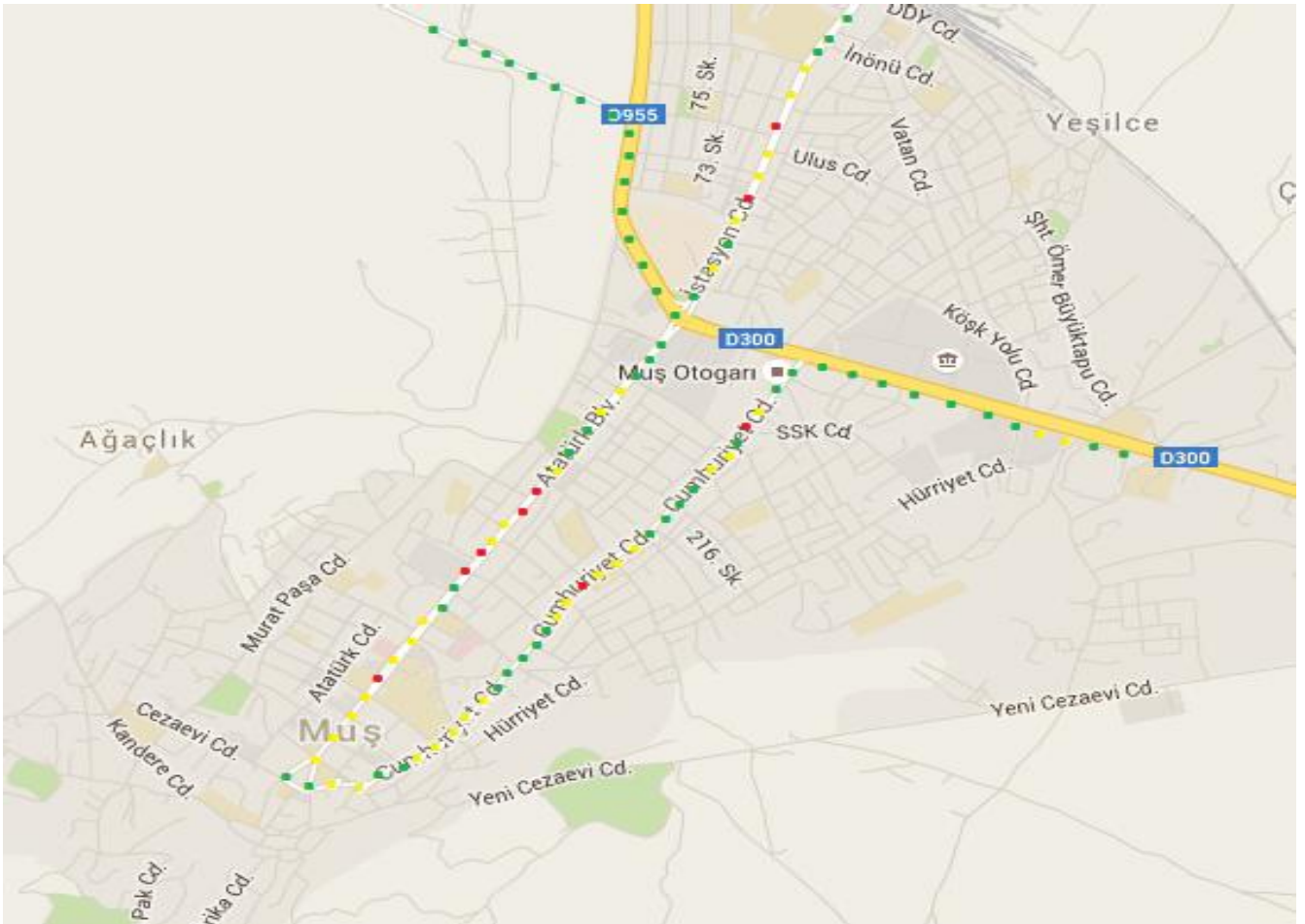


Figure 3. Electric Field Strength Measurement Results in Mus City Center.

4. Conclusions

All measurement values are under the limit values of International Commission on Non-Ionizing Radiation Protection (ICNIRP) and Information and Communication Technologies Authority (ICTA) but some epidemiological shows that electric field values we measured could be dangerous for human being, especially for the children. In countries like Italy and Switzerland limit values for mobile frequencies in some regions are 2 V/m. Especially red points in the map can be dangerous for livings.[6] Lowering output power of some base stations or moving base stations to less dangerous places in the city center can be a solution for high electric field values

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