

## MEASURING MICROWAVE RADIATION PCS

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**Summary:** *The aim of this paper is to present the risks and measures of protection against electromagnetic radiation laptop in the workplace and work environment as well as their general characteristics. Around risks and measures of protection against electromagnetic radiation laptop computers, will be presented to the most common sources of radiation, we meet in our everyday environment, as well as some basic division of radiation and definitions related to microwaves.*

**Keywords:** *electromagnetic radiation protection measures, risks.*

### 1. INTRODUCTION

In the modern world of electromagnetic radiation, it has become very intense, so there is no space on the planet where radiation doesn't reach. The wildlife and even people are constantly exposed to the radiation of different frequencies and wavelengths. In the world, in the last thirty years carried out, a number of studies is in the most prestigious international laboratories, but so far there has been no direct evidence that this radiation is harmful to the human body, unless it is not a short-range radiations from the radiation source.

Also, based on international recommendations and regulations propose certain protection measures to be implemented by all participants in the process of generating electromagnetic radiation. These are the principles for the prevention of adverse impacts and allowable values of electric and magnetic fields that are adopted by the International Association for the Protection of Non-Ionizing Radiation Protection (ICNIRP) and the EU.

### 2. MICROWAVE RADIATION

Microwaves are electromagnetic waves of wavelength from 1 m to 1 mm, a frequency of 300 MHz to 300 GHz. In accordance with the regulations of the International Telecommunication Union (ITU), the microwaves are divided into three frequency bands:

1. Ultra - short waves ultra High Frequency (UHF) frequency range 300 MHz and 3 GHz wavelength 100-10 cm;
2. Super - short waves super high frequency (SHF) of the frequency range 3-30 GHz and the wavelength 10-1 cm;
3. Extra - short waves ekstra high frequency (EHF) frequency range 30-300 GHz and the wavelength 10-1 mm;

UHF microwave radiation used in mobile telephony, UHF-Television (channels 14 - 83), meteorological radars and microwave oven. SHF microwave are used in satellite communications, shipping and aviation radar, the transmission of TV pictures from cosmic radiation ships and the wireless local loop. EHF microwave are used in experimental bands, space research in nuclear physics and technology.

The sources of microwave radiation can be natural or artificial. Natural sources of microwave belligerent originate from the sun and other sources from space. The intensity of natural resources is very small and the man throughout evolution adapted to the natural radiation. Artificial microwave radiation sources are numerous and their intensity is often several billion times greater than the natural background. The most common division of artificial sources of microwave radiation power density and the sources of high power and low power sources.

Sources of high power sources of microwave radiation at a distance of 100 m from the source of radiation, can in the main beam to produce a power density of 1 W / m<sup>2</sup>. These include:

- radars for air traffic control
- control radars land border and coastal belts
- weather radars
- satellite communications
- communication with spacecraft
- radar telescopes to measure the distance of celestial bodies closer
- television transmitters (UHF TV).

Small power sources are those sources of microwave radiation for which there is no requirement specified for high-power sources. These include: police radars, microwave ovens, mobile base stations, mobile phones, cordless phones, microwave radars relay cable TV etc ..

Personal computers have become part of everyday life of modern man and deserve to have their specially trained radiation.

### 3. EFFECT OF RADIATION PCs

Much of the world's population in everyday life use computers. In developed countries, almost every apartment there is at least one computer, and many employees use the computer and the workplace. All this has led scientists around the world to examine the impact of radiation on the health of computer users. Special attention in scientific research is dedicated the most sensitive part of the population: children and pregnant women.

The results of scientific research is pointing to possible negative effects of computer use. The health of computer users may be affected by many factors, some of which are effects of electromagnetic radiation (static and variable fields), consuming a certain posture, prolonged load and visual impairment, the impact of noise and vibration equipment ...

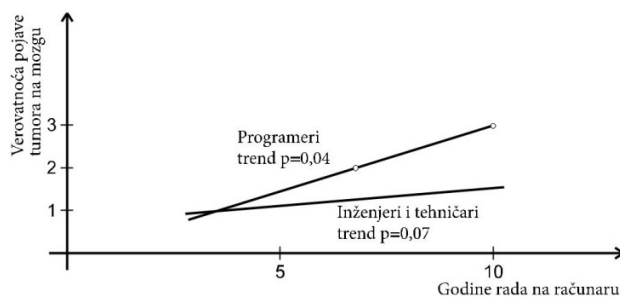
Professor Dr. Neil Cherry wrote about the research and the impact of radiation on the health of your computer:

*"Beal et al. (1997) found a significant increase in tumors in the brain, in particular glioma, the workers who for a long time in the workplace use computers and are exposed to the combined radiation, radio frequency and extremely low frequency, computer and VDT (video display terminal). For those who use the computer for a long time, such as engineers this turned out to have little dosed answer, but the developers show a significant relationship with the dosage response. "* (Cherry, N., 2005)

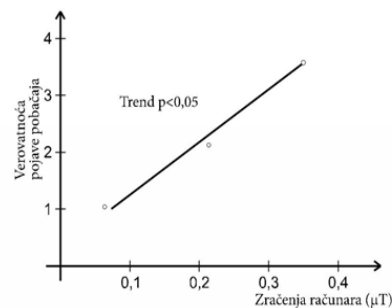
On Pic.1. the influence of long-term use of computers in the workplace programmers, engineers and technicians on the incidence of brain tumors. The figure shows that in ten years programmers who use computers probability of brain cancer increases by almost three times (almost 300%).

Professor Cherry (Cherry, N., 2005), wrote about the effects of computer radiation on the incidence of abortion: *"Professional use of the computer, with the combined exposure to radio frequency radiation and low frequency radiation extremely led to an increase of the dosage response in an abortion, Lindbom et al. (1992) "*.

In Pic. 2 shows the impact of computer radiation on the incidence of abortion in cases of professional population. It is seen that the radiation exposure of computer magnetic induction of 3.5  $\mu\text{T}$  increase the likelihood of miscarriage by more than three times (more than 300%). With us on the impact of electromagnetic radiation computer writing academic Bogosav Lazetić and his associates:



**The picture 1.** An increase of the dosage response in the brain tumor of the challenged long-term work with computers (Beal et al (1997) in Milovanovic V., 2012.)



**Picture 2.** An increase in miscarriage due to occupational use the computer, Lindbom et al. (1992).

*"It must be said that it is an accurate assessment of the biological effects of electromagnetic fields, low-intensity extremely complicated due to the additional influence of other factors that characterize the workplace and a video display terminal users of personal computers, such as - microclimate, noise, optical radiation ...*

*It is well known that in recent years altered the working conditions in many workplaces, the introduction of "clean technology process", which are equipped with computer systems ...*

*Research in the workers indicate activity disorders of the CNS (central nervous system), which is manifested by increased irritability, weakness, the fall of a mood. You are experiencing the symptoms of heart beat, increased blood pressure, pain in the region of the heart, which have the character of piercing, but not related to the physical load may ...*

*Also, research indicates that a longer stay in terms of the operation of the electromagnetic radiation in workplaces with PCs adverse effect on the state of troubled young women with gynecological history. " (Lazetic B., 2004).*

#### 4. ELECTROMAGNETIC RADIATION CRT MONITORS

Cathode ray tube, CRT monitors transmit following types of radiation:

1. The optical radiation. Each CRT monitor in addition to visible light and emits infrared radiation and ultraviolet. Impact of the electron beam on the fluorescent coating on the inner surface of the screen in addition to visible light is produced and invisible infrared ultraviolet and UVA radiation. Ultraviolet radiation of shorter wavelength UVB and UVC, which are harmful to health, CRT monitors manufactured.
2. The static electric field. To be on the screen, cathode ray tubes received a "picture", the energy of the electron beam which bombards a fluorescent coating must be sufficiently large, which is achieved by powerful DC electric fields. Of a CRT monitor is a strong electrical field can be achieved with DC voltage of 10 kV to 30 kV, depending on the type of the cathode ray tube. The high DC voltages and generate static electric fields of high intensity.
3. Static magnetic fields CRT monitor can be compared to the earth's natural static magnetic field that ranges from 35 to 70  $\mu$ T. This type of radiation CRT monitors can be ignored with respect to the time-varying magnetic fields.
4. Time varying electric fields to the CRT monitor frequency is divided into two areas: the first area for frequencies from 5 Hz to 2 kHz, a different area from 2 kHz to 400 kHz. Sources variable electric field in the first area are primarily the power supply frequency of 50 Hz, and the voltage generator that determines the number of changes that frame. "No refreshments". In older monitor this frequency is equal to the network, 50 Hz, and in more recent range from 70 Hz to 120 Hz. Sources variable electric field in the second field generators horizontal line frequency, manage the number of horizontal lines (400 or more) to ensure high picture quality. This frequency is calculated as the product of the number of renewal (refreshments) and the number of horizontal line. Depending on the type of the monitor of this frequency range from 15 kHz to 100 kHz. Variable magnetic field of a CRT monitor is also divided into two areas as well as electric fields, and originate from the same sources. Very near the monitor magnetic induction may amount to several mT, but quickly decreases with increasing distance from the monitor.
5. The X-radiation is formed in small amounts in all the cathode ray tube, from which a portion is absorbed by passing through the glass.

Maximum allowable values of electric and magnetic fields for the monitors are shown in Table 1.

#### 5. ELECTROMAGNETIC RADIATION LAPTOP COMPUTERS

Laptop computers are lightweight and portable HP PCs with a thin screen. They can run on batteries and use anywhere. Because of their size are often called notebook computers .When laptops all located in a single housing: a central processing unit (CPU), screen and keyboard. When not in use, the screen can be folded over the keyboard. Laptop computers have significantly lower levels of radiation than desktop computers, thanks to smaller components, thin LCD or LED screens, but also the possibility of battery power. However, the problem of radiation laptop in a larger rapprochement compared to desktop computers (Table 2) .For longer use of laptop computers is recommended that the use of the mouse and keyboard (not wireless) in order to reduce radiation.

*Table 1. Maximum permitted levels of electric and magnetic fields for monitors*

Frequency range	Types of radiation	MRP II recommendations (Maximum)	TCO recommendations (Maximum)
I 5 Hz – 2 kHz	Time varying electric field	25 V / m to 50 cm in front of the screen	10 V / m to 30 cm in front of the screen
	Time varying magnetic field	250 nT at 50 cm around and in front of the screen	200 nT at around 50 cm or 30 cm in front of the screen

II 2kHz – 400 kHz	Time varying electric field	2.5 V / m to 50 cm around and in front of the screen	1 V / m to about 50 cm or 30 cm in front of the screen
	Time varying magnetic field	25 nT around the screen	25 T around the screen

When using a wireless computer networks or wireless Internet, laptop computers emit radio frequency radiation. If the laptop supports wireless network, one can not exclude the activation wire mesh, but all wireless networks are activated by default and must be manually shut down the Control Panel. After removing the battery comes to resetting the wireless default should turn off again.

*Table 2. Electric and magnetic fields laptop computer at 1-5 cm distance during use*

Mode	ELF Electric field	VLF Electric field	ELF Magnetic field	VLF Magnetic field
Battery	Less than 1 V/m	2-250 V/m	10-2000 nT	10-2000 nT
AC power	1-2500 V/m	5-2000 V/m	20-3000 nT	20-2500 nT

Exposure to electric and magnetic field occurs during active use laptop computers, and exposure is much higher when it is on the charger, ie. When the laptop is connected to the city network.

Some suggestions for reducing the negative impact of electric and magnetic fields laptop computer:

1. Choose low-emission, TCO certified laptops.
2. Choose a laptop with a properly grounded power supply, otherwise the exposure variable (AC) electric field to be significantly higher during use when the laptop is turned into city mains.
3. Do not place the laptop on his knees, no matter how you look comfortable, because it can affect your reproductive abilities.
4. To work longer use external keyboard, as typing on a laptop keyboard electric field can be up to 2500 V / m, magnetic field 3000 nT, a power RF radiation greater than 500000 m W / m<sup>2</sup>.
5. Avoid the use of wireless networks and wireless Internet.
6. If you transfer large amounts of data over a wireless connection, move away from laptops in that period.

## CONCLUSION

Electromagnetic radiation, ionizing and non-ionizing, when it comes to quality of life, can be viewed from two aspects. The first is their impact on the development of human society, and the other is their impact on human health. Today's civilization is widely used electromagnetic waves and fields in a variety of technologies. Thus, communications, radio and television, electricity, transport, medicine, computers, are designed to electromagnetic fields and electromagnetic radiation.

This progress has enabled human beings high quality of life, which until only a century ago could not have imagined. The breakthrough of the universe and its study is unthinkable without the electromagnetic waves, as well as breakthrough into the world of microparticles. Their contribution to the development of modern civilization has immense importance.

On the other hand, the negative impact of electromagnetic radiation which in certain circumstances can cause health problems in humans (close to the source of radiation, radiation power, frequency waves, ionization). In addition, ionizing radiation are much more dangerous to human health from non-ionizing.

## LITERATURE

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