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Hazardous Effects of Electromagnetic Radiation Emitted from Solid State Electronic Devices

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In this research work, the electric and magnetic fields emanating from electronics devices were established and critically studied. Electromagnetic radiation has been considered as a self-transmission wave found in the Universe or through visible material. The components of electromagnetic radiation are electric and magnetic field component, which oscillate in phase perpendicular to each other and also to the direction of energy propagation. The electromagnetic radiation majorly comprises of radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, x rays and gamma rays. In this study, different home appliances were chosen from home and offices. These are Laptop computer, LED television, and collection of data from hot spot area inside the residential. Measurements were taken at 10 cm, 20 cm, 30 cm, 40 cm, 50 cm, 60 cm, 70 cm, 80 cm, 90 cm, and 100cm away from the source. The electromagnetic radiation was examined using ELF Detection Meter known as cell sensor. It was examined that emission of zero radiation cannot be realized but through safety measures protection from harmful radiation is achievable. The highest electric field of 2.6001 V/m, magnetic field of 1.2501 V/m and power density of 1.981 V/m were shown by hot spot while the lowest values of 1.8090 V/m, 0.9261 V/m and 0.0507 V/m were recorded for television at distance 10 cm from the sources. The values recorded for computer at 10 cm from the source are 2.5431 V/m, 1.1820 V/m and 0.9021 V/m, respectively. The values decreased as the distance from the source of the radiation increased from 10 cm to 100 cm. Zero electromagnetic radiation were recorded at 100 cm from the sources.

1. Introduction

On a daily basis, most Nigerians are exposed to ELF generated by household wiring, fluorescent lighting, and any electrical appliance that plugs into the wall, including hair dryers, vacuum cleaners and toasters. In the workplace, common sources include video display terminals (computer monitors), air purifiers, photocopiers, fax machines, fluorescent lights, electric heaters and electric tools in machine shops, such as drills, power saws, lathes and welding machines. Computer and television screens also used for video games function on the same principle like a fine jet of water projected against a wall, a beam of fast electrons sweep, the fluorescent surface of the screen where point by point, it draws a luminous image. This would not be a problem if the energy from the electrons was limited to providing the image. But some of this energy escapes in the form of radiation at various frequencies, in particular VLF and ELF (very low frequency and extremely low frequency) fields. The spot of electrons, which sweep the screen, generates PEMR (Pulsed Electro-Magnetic Radiation) which at close range disturbs the balance of all living cells. It has been established that the harmful effects of PEMR exist all around the screen, especially in front of and behind the tube, effects which persist for several hours [1].

Very-low-frequency electric and magnetic fields are known or suspected to interact with biological systems in a number of ways. Some biological effects at high field strengths, such as nerve stimulation and tissue heating, are well understood and have been used to set standards for occupational and public exposure to fields. Other reported effects particularly at low field strengths are not as well understood; those include effects on cell metabolism and growth, gene expression, hormones, learning and behavior, and promotion of tumors. The term biological effect is intended to be a neutral term; it implies no judgment about whether an effect is good or bad. Some biologic effects of electric and magnetic fields have already been found to be beneficial; for example, the ability of fields to stimulate tissue and bone growth has been known and used for a number of years to speed the healing of fractures and burns. Other effects might be harmful.

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In 1972, Soviet researchers [2] linked electromagnetic fields with low grade health problems such as fatigue and headaches. In 1977, Becker and Marino [3] testified before the New York State Public Service Commission about the results of their experiment that showed negative health effects due to exposure to ELF fields (Iovine [4]). In the same report, Nancy Wertheimer worked on the statistical link between childhood cancers and the proximity of certain types of high-current power lines to the home. Iovine also reported that a Washington State study examined the data for the deaths of 438,000 workers in the State occurring between 1950 and 1979. The results of the study showed that leukemia deaths were elevated in 10 out of 11 occupations where the workers were exposed to ELF fields [4]. In 1986, Dr. Bernard Tribukait, a professor of radiobiology at the Karolinska Institute in Stockholm Sweden, reported that the foetuses of mice exposed to saw tooth electromagnetic fields had a greater incidence of congenital malformation than unexposed mice. The saw tooth waveform is a typical waveform generated by monitors and TV's [4]. In 1988, the Maryland Department of Health and Hygiene found an unusually high rate of fatal brain cancer among men employed in electrical occupations. In 1989, John Hopkins University found an elevated risk of all cancers among New York Telephone Company cable splicer. In 1990, David Savitz, an epidemiologist at the University of North Carolina, determined through a study that pregnant woman who used electric blankets have children who have a 30% increased risk of cancer as compared to children whose mothers did not use electric blankets [4].

2. Methodology

ELF investigations were carried out using an ELF Detection Meter known as cell sensor (Model Extech 480823) manufactured by Action Electronic, USA. It is a device optimized to measure radio frequency and extremely low frequency (ELF) field. The Extech 480823 EMF/ELF meter allows measurement of electromagnetic field radiation levels from fans, electrical appliances, wiring, and computers. With a large ½" LCD display and a sampling time of 2.5 times per second, one can be assured of easy and accurate measurements.

In this study, different home appliances were chosen from home and offices. These are computer, LED television, and collection of data from hot spot area inside the residential. Measurements were taken at 10cm, 20cm, 30cm, 40cm, 50cm, 60cm, 70cm, 80cm, 90cm, and 100cm away from the source. The background radiation (radiation from other devices) was obtained with each of the systems switched off and each background radiation was deducted from total radiation obtained in order to obtain the actual value for each case. The EM field investigation was carried out along the horizontal axis so as to measure the presence of EM Field. The ELF measurements were carried out during the office hours between 10:00am and 4:00pm with all the electronic gadgets in use.

3. Results

Table 1: Comparison of electric field strength obtained for home appliances

Distance(cm)	E - CP (V/m)	E –HS (V/m)	E-TV (V/m)
10	2.5431	2.6001	1.8090
20	2.1521	1.8781	0.6423
30	1.8021	1.2654	0.5000
40	1.3210	0.6009	0.3010
50	0.8310	0.3871	0.1231
60	0.5213	0.1113	0.0807
70	0.1417	1.009	0.0446
80	0.0802	0.8941	0.0500
90	0.0523	0.0700	0.0302
100	0.0000	0.0000	0.0000

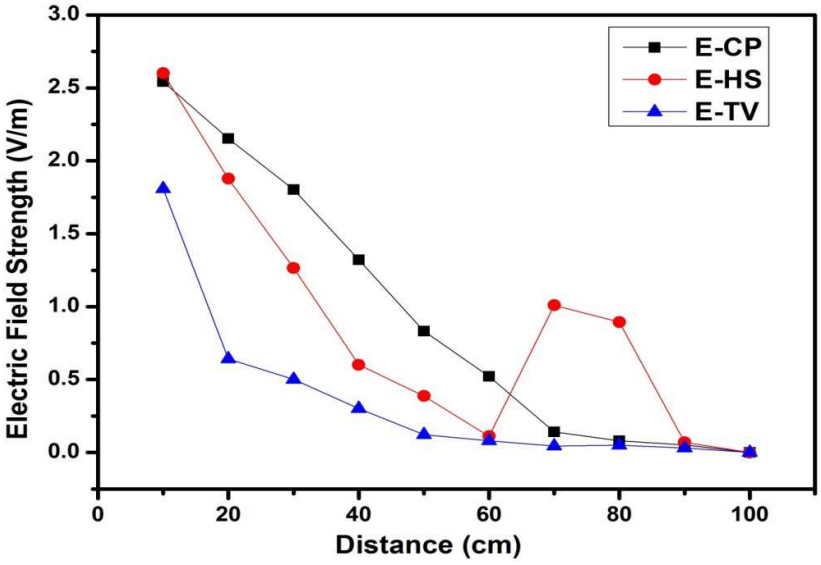

Fig.1: Comparison of electric field strength measured from CP, HS and TV appliances

Table 2: Comparison of magnetic field strength obtained from home appliances

Distance(cm)	H-CP (A/m)	H-HS (A/m)	H-TV (A/m)
10	1.1820	1.2501	0.9261
20	0.9502	1.8521	0.6771
30	0.6111	0.8213	0.3009
40	0.4435	0.5060	0.1423
50	0.1970	0.2981	0.0809
60	0.0800	0.0700	0.0532
70	0.0502	0.0556	0.0311
80	0.0500	0.0313	0.0200
90	0.0123	0.0111	0.0100
100	0.0000	0.0000	0.0000

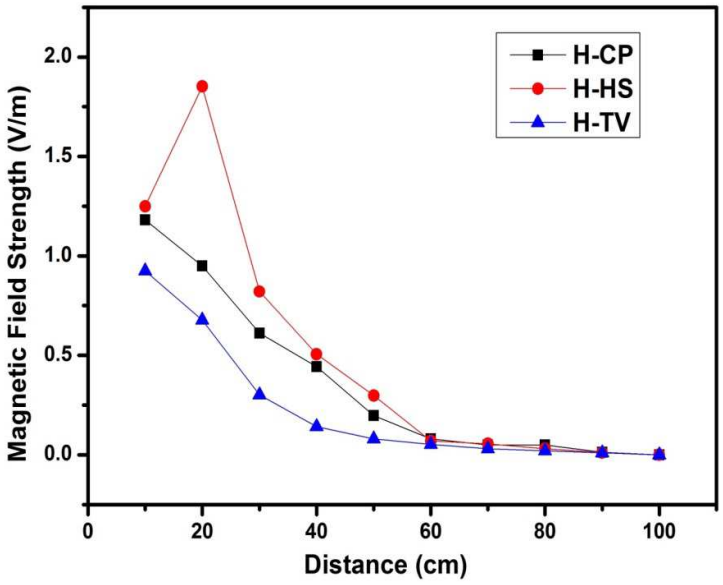

Fig.2: Comparison of magnetic field strength measured from CP, HS and TV appliances

Table 3: Comparison of Power density obtained from home appliances

D(cm)	S-CP(W/m)	S-HS(W/m^2)	S-TV (W/m^2)
10	0.9021	1.9810	0.0507
20	0.5673	0.7562	0.3912
30	0.4437	0.6431	0.2091
40	0.2008	0.4206	0.1142
50	0.0971	0.1712	0.0509
60	0.0501	0.0807	0.0511
70	0.0376	0.0211	0.0000
80	0.0100	0.0102	0.0000
90	0.0000	0.0000	0.0000
100	0.0000	0.0000	0.0000

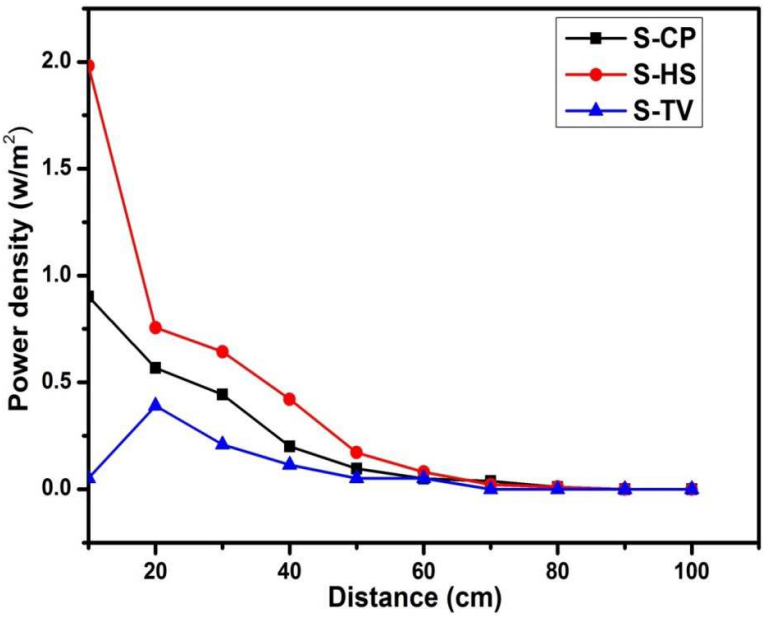

Fig.3: Comparison of power density measured from CP, HS and TV appliances

The electric field measured at different distance from three different home appliances Computer (CP), Hot spot (HS) and Television (TV) is represented in Fig. 1. It is observed that the value of electric field strength decay gradually as the distance increases from 10 cm to 100 cm. At the shortest distance 10 cm TV has the least value of electric field strength and with a little difference between the value obtained from HS and CP, the highest value is measured from HS. With the 20% difference between TV, HS and CP values people living with HS are prone to more danger of exposure to higher electric field strength than those living with TV. Increasing the distance is a possible means of reducing the amount of electric field strength absorbed into the body. This can be achieved by using wireless device to communicate with the hotspot. Since the magnetic field strength travels far from the source compared to the electric field strength and it virtually passes through all materials and affects us more compared to the electric field (Andrew [5] and Maina et al. [6]). The magnetic field measured from CP, HS and TV at increasing distance from 20 cm to 100 cm is as shown in Fig. 2. The value reduces gradually as the distance from the source increases. It is also observed that HS has the highest value of magnetic field measures with TV giving the least value. At the shortest distance there is a 10% difference between the value measured from TV, CP and HS. A jump was observed in the value of HS at 20 cm distance which can be because of sudden unexpected circumstances. At 60 cm to 100cm no significant difference was observed in the value of magnetic field strength measured from three appliances. Hence, the risk exposure which is very high for HS at 20 cm distance can be reduced at these distances 60 cm up to 100 cm. A possible means can be as suggested for electric field. Since the power density also have a relationship with the electric field and magnetic field the graph of power density with respect to distance is shown in Fig. 3 which confirms there is also decay in the value of the power density as the distance to the appliances increases.

4. Conclusion

The Electromagnetic Radiation generated by the electronic appliances such as desktop computers, television and hot spot appliances were proposed. The electromagnetic radiation becomes attenuated as the distance increase from 10 cm to 100 cm while zero radiation was achieved at 100 cm from the various sources. This showed that no health hazard will be recorded when staying 100 cm away from the mentioned equipment.

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