

# Investigation on Effect of Radiation from Laptop Parts

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## ABSTARCT

Laptop radiation known as extremely low frequency (ELF) radiation is generated from different parts of laptop such as monitor, mouse pad, keyboard, and heat sink. A study conducted using cell sensor to measure radiation level from these laptop parts revealed that radiation decreases as the distance from the laptop increases. The measured radiation level ranged range from 2 mG to 0.33 mG and 0.5 mG to 0.15 mG for the LCD screen at distances ranging from 5cm to 50cm for normal and high sensitivity setting respectively. Similarly, the keyboard exhibited radiation values of 1.8 mG to 0.16 mG and 1.6 mG to 0.79 mG, while the Mouse pad showed the radiation values of 1.0 mG to 0.079 mG and 1.0 mG and 0.75 mG, again for normal and high sensitivity respectively at the same distance of 5cm to 50cm. The heat sink displayed radiation values of 2.5 mG to 0.8 mG and 1.5 mG to 0.75 mG for normal and high sensitivity respectively, within the same distance range. When considering the average radiation values for the four different parts under normal sensitivity, the Heat Sink exhibited highest radiation level, followed by LCD screen, Keyboard and Mouse Pad with average values of 1.395 mG, 0.992 mG, 0.687 mG and 0.3444 mG respectively. However, under high sensitivity, the Keyboard had highest radiation level followed by Heat Sink, Mouse Pad and LCD Screen with average values of 1.114 mG, 0.975 mG, 0.869 mG and 0.266 mG. Based on the investigation, it is recommended to place the laptop between 40cm to 50cm away from the laptop user to minimize laptop exposure.

**Keyword:** Normal and High Sensitivity, Cell Sensor, Extremely low frequency (ELF), Radiation, LCD Screen, Keyboard, Mouse pad, and Laptop

## I. INTRODUCTION

Laptops are very essential devices used by different individual to perform different task. It can

be used to computes student results, used for presentation, typing of document, running of different programs etc. despite the good usage of the laptop, it as well emit extremely low frequency (ELF) radiation which is in milliGauss. [1]

Laptops have become an essential tool in our modern lives providing us with ability to connect to the internet and perform various tasks on the go. They utilize different technologies, such as WiFi, 5G, and Bluetooth, to establish connections with the internet and other devices like tablets. These technologies enable us to access information, communicate with others and engage in a wide range of online activities [2].

The transmitter and receiver components within a laptop are responsible for establishing and maintaining these wireless connections. The transmitter sends out signals, while the receiver captures and interprets signals from other devices or networks. This communication between the laptop and external devices or network allows for data transfer, internet browsing, file sharing and more[3].

However, it's important to note that when a laptop is place directly on the lap, there can be potential health concerns. Laptop emits extremely low frequency electromagnetic radiation as a byproduct of their wireless communication. This radiation is absorbed by the body, particularly in the areas of direct contact, such as the lap. [4]

While the health effect of this low-frequency radiation are still a subject of ongoing research and debate, it is generally, recommended to use laptops on a hard surface or with a lap desk to minimize direct contact and reduce exposure to the emitted radiation.

Furthermore the internal component of a laptop, including the processor, memory hard drive and other circuitry, are typically positioned beneath the keyboard and mouse pad. These components generate heat during operation, and laptops are

designed with cooling mechanisms such as fans and heat sink to dissipate this heat. Placing a laptop on a soft surface, like a pillow or blanket, can obstruct proper air flow and ventilation, potentially leading to overheating and performance issues.

When it comes to radiation emitted by laptops, it's important to understand that there are different types of radiation involved. One type is electromagnetic radiation, which includes radio waves, microwaves, infrared, visible light and more. Another type is thermal radiation which is heat generated by the laptop components [5].

In the case of laptops, the main concern is electromagnetic radiation, particularly the radio waves and micro waves used for wireless communication. These waves are generally considered to be non-ionizing radiation, which means the lack sufficient energy to cause ionization in biological tissues.

The radiation emitted by laptops even when placed a few feet away, is typically considered to be safe for most people. Regulatory bodies and industry standards have established guidelines and limits to ensure that the radiation levels from electronic devices, including laptops, remain within acceptable safety limits [4].

Compared to desktop PCs, laptops do tend to emit lower level of radiation. This is due to several factors. First, laptops have smaller components, which generally produce lower electromagnetic radiation compared to larger desktop components. Additionally, laptops commonly use LCD or LED screens which emit less radiation than older CRT monitor used in desktop PCs. Laptops are primarily powered by batteries which reduce the need for direct electrical connections and further lower radiation emission [6].

It's worth noting that while the radiation emitted by laptop is generally considered to be safe, individual sensitivities and health conditions can vary. Some individual may be more sensitive to electromagnetic field or have specific health concern that warrant taking extra precautions.

## II. REVIEW OF SOME LITERATURE

A lot of research has been carried out and some are still on-going by researchers on how radiation from laptop affects the users. Some of their works are presented below:

[7] Conducted a study focused on analyzing durability of radiator and laptop cooler using thermal analysis. Their result indicated that the laptop cooler exhibited greater durability than the radiator.

[8] Study extremely low frequency magnetic field produce by laptop computers. The K-medians method was employed to identify the critical position of the 13 laptop computer used for the experiment. They compared the result obtained with that and ICNIRP and found out that some laptop computers generate higher low frequency magnetic field.

[9] Evaluated and validated Five laptops of different brand. It was observed that EMF values varies from 1.8-6  $\mu$ T and is within the international commission on Non-Ionizing Radiation protection guidelines but higher than the values recommended by Swedish board for technical accreditation and Swedish confederation of professional employees. They affirm that laptop induces current when in contact with body at 34.2% to 49.8% .

The study conducted by [10] using simple random sampling to select 112 respondent. The result indicated that laptop radiation expose the user to decrease in sleep quality, headache and disturbance concentration.

## III. AIM & OBJECTIVES

The aim of the research is to investigate intensity of radiation from laptop.

The objectives are;

1. To know the laptop radiation level
2. To understand and know how to use cell sensor to measure radiation from laptop level
3. To know to what distance laptop needs to be placed from the user

## IV. METHODOLOGY

The methodology employed in this work, is the use of cell sensor

### 4.1 Cell Sensor

A cell sensor is a meter used to measure extremely low frequency field (ELF) in milliGauss (mG) and is shown in the bottom scale of the display marked as "Power (ELF)" using green colour [11].

This meter measure in two different ELF scales. The "Normal sensitivity" scale is 1 to 50 milliGauss while the "High sensitivity" scale is 1 to 5 milliGauss. The display however is only marked with high sensitivity scale.

For example, while on the "high sensitivity" scale, a reading of 2 corresponds to 2 milliGauss. However, while on the "normal sensitivity" mode a reading of 2 corresponds to 20 milliGauss.

The sliding switch located on the right hand side of the unit, above the volume control, is used to switch between the two sensitivities marked "H"

for “high sensitivity” and “N” for normal sensitivity.



Fig 4.1(a) Cell Sensor showing top and bottom scale.



Fig 4.1(b) side view showing the sliding switch and control knob

The result obtained when four different parts of HP laptop was measured using cell sensor in shown in table 1-table 8.

Table 1: LCD Screen

S/N	Distance (cm)	Normal Sensitivity	High Sensitivity
1	5	2 mG	0.5 mG
2	10	1.8 mG	0.4 mG
3	15	1.7 mG	0.35 mG
4	20	1.5 mG	0.3 mG
5	25	1.0 mG	0.25 mG
6	30	0.5 mG	0.2 mG
7	35	0.4 mG	0.18 mG
8	40	0.35 mG	0.17 mG
9	45	0.34 mG	0.16 mG
10	50	0.33 mG	0.15 mG
	Average	0.992 mG	0.266 mG

Table 2: Keyboard

S/N	Distance (cm)	Normal Sensitivity	High Sensitivity
1	5	1.8 mG	1.6 mG
2	10	1.5 mG	1.5 mG
3	15	1.2 mG	1.4 mG
4	20	1.0 mG	1.2 mG
5	25	0.5 mG	1.1 mG
6	30	0.2 mG	1.0 mG
7	35	0.18 mG	0.9 mG
8	40	0.17 mG	0.85 mG
9	45	0.16 mG	0.8 mG
10	50	0.16 mG	0.79 mG
	Average	0.687	1.114

Table 3: Mouse Pad

S/N	Distance (cm)	Normal Sensitivity	High Sensitivity
1	5	1.0 mG	1.0 mG
2	10	0.8 mG	0.8 mG
3	15	0.6 mG	1.0 mG
4	20	0.4 mG	1.0 mG
5	25	0.2 mG	1.0 mG
6	30	0.1 mG	0.8 mG
7	35	0.095 mG	0.79 mG
8	40	0.09 mG	0.78 mG
9	45	0.08 mG	0.77 mG
10	50	0.079 mG	0.75 mG
	Average	0.3444	0.869

Table 4: Heat Sink

S/N	Distance (cm)	Normal Sensitivity	High Sensitivity
1	5	2.5 mG	1.5 mG
2	10	2.0 mG	1.2 mG
3	15	1.8 mG	1.1 mG
4	20	1.7 mG	1.0 mG
5	25	1.5 mG	1.1 mG
6	30	1.0 mG	0.8 mG
7	35	0.9 mG	0.78 mG
8	40	0.9 mG	0.77 mG
9	45	0.85 mG	0.75 mG
10	50	0.8 mG	0.75 mG
	Average	1.395	0.975

After 3 Hours of Charging

Table 5: LCD Screen

S/N	Distance (cm)	Normal Sensitivity	High Sensitivity
1	5	2 mG	0.45 mG
2	10	1.8 mG	0.42 mG
3	15	1.7 mG	0.4 mG
4	20	1.6 mG	0.3 mG
5	25	0.8 mG	0.3 mG
6	30	0.5 mG	0.28 mG
7	35	0.49 mG	0.27 mG
8	40	0.48 mG	0.26 mG
9	45	0.46 mG	0.25 mG
10	50	0.46 mG	0.25 mG
	Average	1.029 mG	0.288 mG

Table 6: Keyboard

S/N	Distance (cm)	Normal Sensitivity	High Sensitivity
1	5	1 mG	0.9 mG
2	10	0.9 mG	0.85 mG
3	15	0.8 mG	0.75 mG
4	20	0.5 mG	0.7 mG

5	25	0.3 mG	0.5 mG
6	30	0.1 mG	0.5 mG
7	35	0.09 mG	0.45 mG
8	40	0.085 mG	0.4 mG
9	45	0.08 mG	0.38 mG
10	50	0.079 mG	0.36 mG
	Average	0.3934	0.579

Table 7: Mouse Pad

S/N	Distance (cm)	Normal Sensitivity	High Sensitivity
1	5	1.8 mG	4 mG
2	10	1 mG	3.5 mG
3	15	0.5 mG	3.0 mG
4	20	0.4 mG	2.8 mG
5	25	0.2 mG	2.7 mG
6	30	0.2 mG	2.7 mG
7	35	0.19 mG	2.69 mG
8	40	0.18 mG	2.67 mG
9	45	0.18 mG	2.68 mG
10	50	0.17 mG	2.65 mG
	Average	0.482	2.939

Table 8: Heat Sink

S/N	Distance (cm)	Normal Sensitivity	High Sensitivity
1	5	3 mG	1.1 mG
2	10	2.8 mG	1.0 mG
3	15	2.5 mG	0.9 mG
4	20	1.5 mG	0.8 mG
5	25	1.2 mG	0.75 mG
6	30	1.0 mG	0.7 mG
7	35	0.09 mG	0.65 mG
8	40	0.08 mG	0.63 mG
9	45	0.08 mG	0.62 mG
10	50	0.07 mG	0.60 mG



Fig 4.2 Measurement of ELF from keyboard using Cell sensor

The simulation result of the radiation is shown from fig 4.3 to fig 4.6

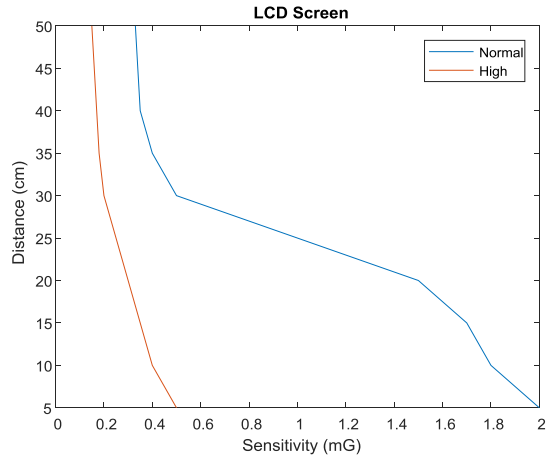


Fig 4.3 (a) LCD Screen

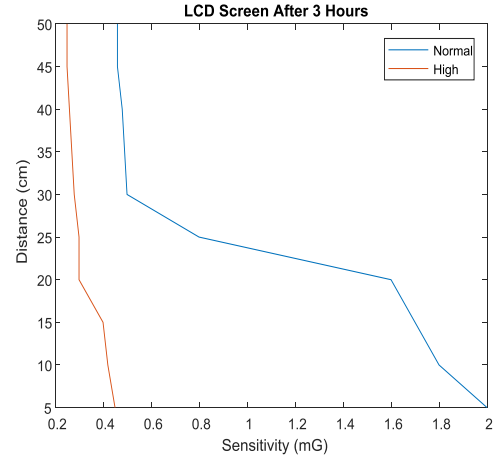


fig 4.3(b) LCD Screen after 3 hours

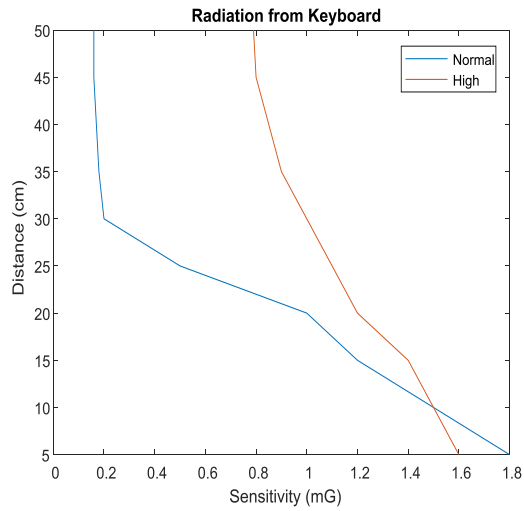


Fig 4.4(a) Keyboard radiation

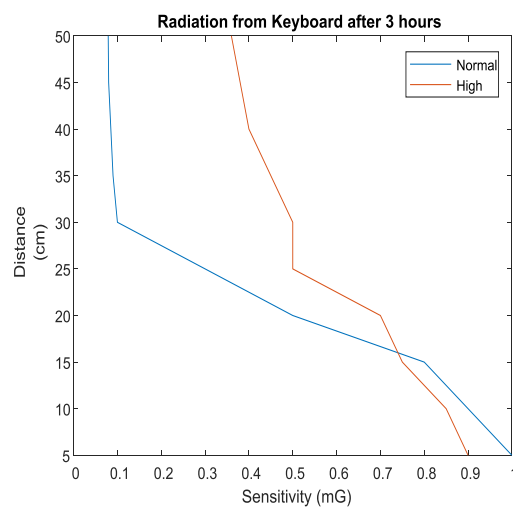


fig 4.4 (b) Keyboard radiation after 3 hours

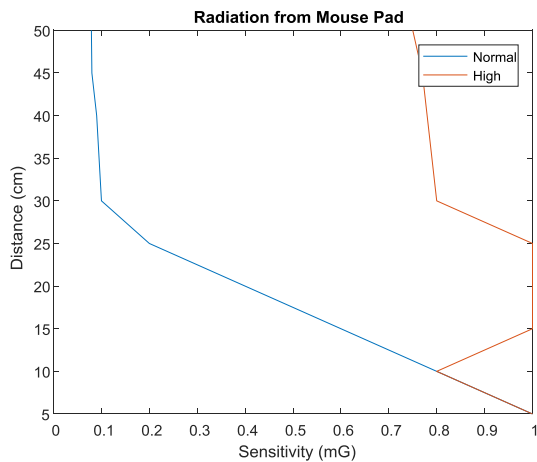


Fig 4.5(a) Mouse pad radiation

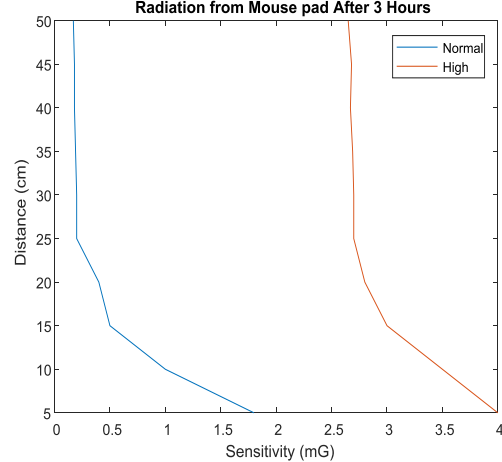


fig 4.5 (b) Mouse pad radiation after 3 hours



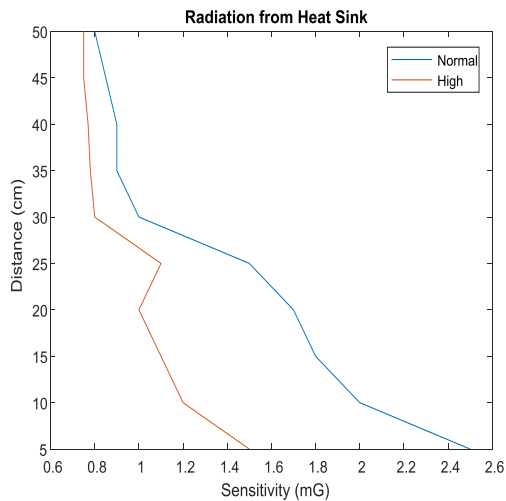


Fig 4.6 (a) Heat sink radiation

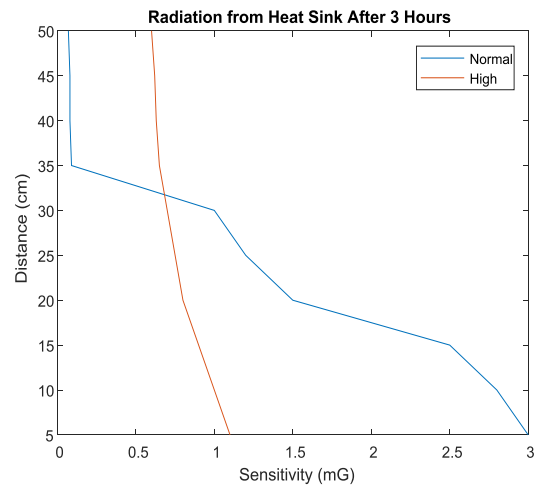


fig 4.6(b) Heat sink radiation after 3 hours

## V. DISCUSSION OF RESULT

The analysis of radiation level of radiation from the monitor indicates that for fig 4.3(a), at 5cm, the radiation levels are 2.0 mG and 0.5 mG for normal and high sensitivity, respectively. However at distance 50cm the radiation levels decrease to 0.33 mG and 0.15 mG for normal and high sensitivity. Similarly in figure 4.3(b), the radiation levels are 2 mG and 0.45 mG for 5cm for normal sensitivity, while at distance of 50cm, they drop to 0.46 mG and 0.25 mG for normal and high sensitivity.

Also fig 4.3(a) exhibits an average lower radiation values of 0.992 mG and 0.266 mG for normal and high Sensitivity, respectively, in comparison to fig 4.3 (b) which has radiation values of 1.029 mG and 0.288 mG for Normal and High sensitivity respectively.

The radiation emitted by keyboard in fig 4.4 (a) varies depending on the distance. At 5cm, the radiation levels are 1.8 mG and 1.6 mG for normal and high sensitivity, respectively. However at distance 50cm the radiation levels decrease to 0.16 mG and 0.79 mG for normal and high sensitivity. Similarly in figure 4.4(b), the radiation levels are 1 mG and 0.9 mG for 5cm for normal sensitivity, while at distance of 50cm, they drop to 0.079 mG and 0.36 mG for normal and high sensitivity. When comparing the average radiation levels, figure 4.4(a) shows higher values of 0.687 mG and 1.114 mG for normal and high sensitivity respectively, whereas figure 4.4(b) has average values of 0.3934 mG and 0.579 mG for normal and high sensitivity radiation levels.

Again for Mouse pad, in fig 4.5(a) at 5cm, the radiation levels are 1.0 mG and 1.0 mG for

normal and high sensitivity, respectively. However at distance 50cm the radiation levels decrease to 0.079 mG and 0.75 mG for normal and high sensitivity. Similarly in figure 4.5(b), the radiation levels are 1.8 mG and 4.0 mG for 5cm for normal and high sensitivity, while at distance of 50cm, they drop to 0.17 mG and 2.65 mG for normal and high sensitivity. When comparing the average radiation levels, figure 4.5(a) shows lower values of 0.3444 mG and 0.869 mG for normal and high sensitivity respectively, whereas figure 4.5(b) has average values of 0.482 mG and 2.939 mG for normal and high sensitivity radiation levels.

Furthermore, for Heat Sink, at 5cm, the radiation levels are 2.5 mG and 1.5 mG for normal and high sensitivity, respectively as seen in fig 4.6(a). However at distance 50cm the radiation levels decrease to 0.8 mG and 0.75 mG for normal and high sensitivity. Similarly in fig. 4.6(b) b, the radiation levels are 3.0 mG and 1.1 mG for 5cm for normal and high sensitivity, while at distance of 50cm, they drop to 0.07 mG and 0.60 mG for normal and high sensitivity. When comparing the average radiation levels, figure a indicates higher values of 1.395 mG and 0.975 mG for normal and high sensitivity respectively, whereas figure b has average lower values of 1.232 mG and 0.775 mG for normal and high sensitivity radiation levels.

## VI. CONCLUSION

The radiation from laptop parts with the aid of cell sensor revealed that radiation decreases as the distance increases which range from 2 (mG) to 0.079 mG and 1.6 mG to 0.15 mG for normal and high sensitivity for distance of 5cm to 50cm for Monitor, keyboard, Mouse pad and Heat Sink. The

average radiation values also indicated that among four different parts considered for normal sensitivity, Heat Sink has highest radiation values, followed by Monitor, Keyboard and Mouse Pad with average values of 1.395 mG, 0.992 mG, 0.687 mG and 0.3444 mG while for high sensitivity radiation, the Keyboard has highest radiation level followed by Heat Sink, Mouse Pad and monitor with average values of 1.114 mG, 0.975 mG, 0.869 mG and 0.266 mG. The investigation also shows that laptop can be placed between 40cm to 50cm away from the laptop user.

#### Recommendation

It is recommended that laptop should be placed 40cm to 50cm away from the laptop User.

#### Benefit of the Research

The research has shown the level of radiation from different laptop parts as well as distance at which laptop should be kept for continuous safety of the user.

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