



# INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

A PATH FOR HORIZING YOUR INNOVATIVE WORK

## REDUCING RADIATIONS IN MOBILE PHONES USING FERRITE BEADS

SARITHA L. R.

Assistant Professor, Department of Information Technology, SIES GST, Nerul, Navi Mumbai, India.

Accepted Date: 15/02/2014 ; Published Date: 01/04/2014

**Abstract:** Cell phone radiation is a real concern. Ferrite beads are safety accessories attached to cell phone headsets to reduce exposure to radio frequencies that can disrupt brain function. A ferrite bead is simply a hollow bead or cylinder made of ferrite, which is a semi-magnetic substance made from iron oxide alloyed with other metals. Ferrite beads work by reducing the RFI (radio-frequency interference) created by these cables.

**Keywords:** RFI (radio-frequency interference), electromagnetic radiation, mobile phone, Bluetooth headset,



PAPER-QR CODE

Corresponding Author: MS. SARITHA L. R.

Access Online On:

[www.ijpret.com](http://www.ijpret.com)

How to Cite This Article:

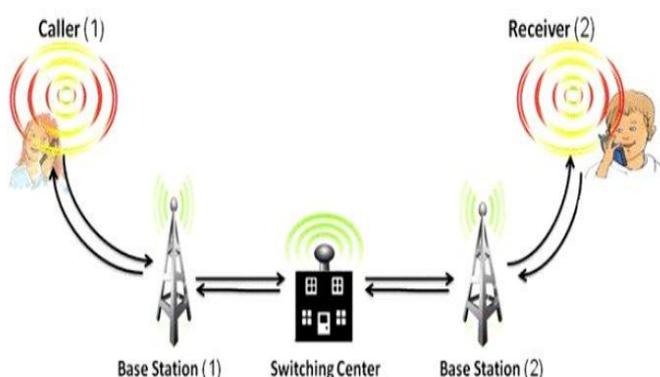
Saritha LR, IJPRET, 2014; Volume 2 (8): 591-599

## INTRODUCTION

Cell phones are designed to transmit radio waves in all directions because base stations can be located in any direction with respect to phone users. This means that portions of the radio waves they produce are directed towards your body. Studies show that exposure to the electromagnetic wave for a certain period of time will lead to health problems such as headaches, memory loss or even worse, brain cancer. Speakerphone will greatly decrease exposure to both EMFs and radio frequencies (RF). However in a noisy environment or it just isn't convenient to use, can use a ferrite bead attached to headset as another option. While they do not block EMFs, ferrite beads are an effective solution to limit unwanted RF interference, which may help decrease their tissue-heating effects on your brain. Ferrite bead is most commonly used with computer cables- on the mouse, keyboard and monitor cables.

## II. POTENTIAL HEALTH CONCERNS CAUSED BY RADIATION

The exposure of the radiation using handsets is more because they are in direct contact with the human brain. RF radiation emitted from mobile phone has effects on human health which can be categorized as thermal, non-thermal. Non-specific complaints had been made by mobile phone users such as symptoms like headaches, earaches, blurring of vision, short term memory loss, numbing, itchy, burning sensations, bad sleep, electromagnetic hypersensitivity exhaustion and anxiety when using mobile phone. Recent investigations tell us that headsets may actually intensify your exposure to harmful EMFs emitted by your cell phone. Research conducted by British consumer research magazine indicates that hands-free cell phone kits may significantly increase your brain's exposure to radiation. The findings confirmed claims that using hands-free earpieces in certain positions could more than triple your brain's exposure to radiation compared to a conventional cell phone call. By itself, headset can act as an antenna that actually channels radiation to your brain.



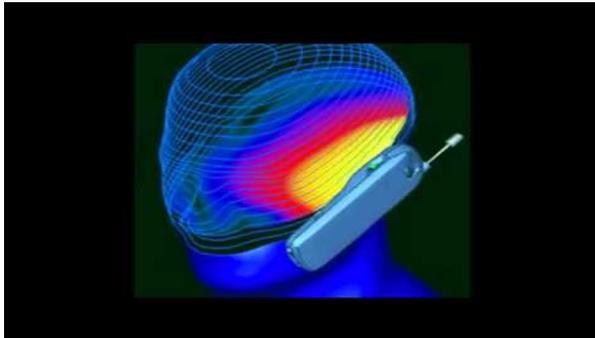


Fig 1: Mobile phone radiation

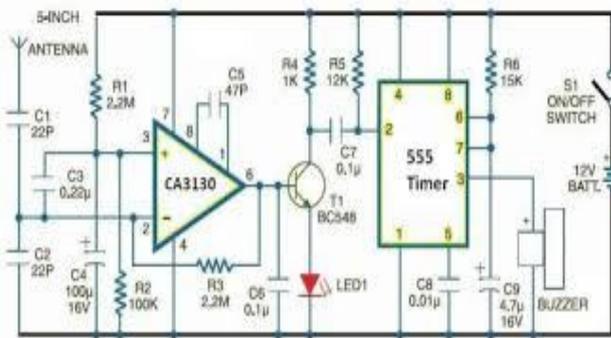


Fig: 2 Mobile phone radiation detection Circuit[2]

### Radiation Measurement at various locations

Cumulative Readings including CDMA, GSM 900, and GSM 1800

Location	Reading in dBm	Readings in W/m2	Readings in microW/m2
Terrace, New Rajindra Nagar, Delhi	+09	0.561	561.479
Resident 1, Bedroom - Chowpatty	+06	0.281	281.406
Resident 2, Bedrooms - Opera House	+05	0.223	223.529
Resident 3, Bedroom – ML Dahanukar Marg	+05	0.223	223.529
Delhi-Gurgaon Highway - near Toll (3 towers)	0	0.0706	70.686
Nashi Bridge - after Railway Station	-4	0.0282	28.274
Resident 3, 4 <sup>th</sup> Fl Sergean House Lady w/cancer	-6	0.0177	17.756
Resident 4, Dadar East, Lady w/cancer	-6	0.0177	17.756
Resident 5, Opposite roof, Rane Society, Powai	-10	0.00706	7.069
Ustav Chowk, Kharghar	-12	0.00446	4.460
Govandi- Residential towers - near Indian Oil	-14	0.002814	2.814
Lower Parel Employees-headaches, forgetfulness	-16	0.001776	1.776
Nashi Highway – near Turbhe	-18	0.001120	1.120
Nerul Bridge	-20	0.000707	707
Vnero pre School (opposite powai lake)	-22	0.000446	446
Rajeev Gandhi nagar	-26	0.000177	177
On road near Evita (Hiranandani Building)	-28	0.000112	112
D-Mart,Hiranandani, Powai	-34	0.0000280	28
IIT Bombay School of Management - Entrance	-46	0.00000178	1.78

Fig: 4 Radiation measurement at different locations in Mumbai[2]

Body Part	Radiation Absorbed in milli Watt/kg		
	In Adults	In 10 year old Kids	In 5 year old Kids
Head	7.84	19.77	33.12
Eye Fluid	3.30	18.38	40.18
Eye Lens	1.34	6.93	15.60
Connective Tissue	1.77	9.8	19.69

Fig: 3 Radiation absorbed in kids www.environmentalhealthtrust.org

The younger the child, the deeper the penetration due to the fact that their skulls are thinner and still developing.

### III.1. RECOMMENDATIONS OF INDIA'S INTER MINISTERIAL COMMITTEE REPORT

1. Reduce RF emission to one-tenth of current levels in densely populated areas
2. Reduce SAR levels
3. Set up a monitoring network
4. Tropical Indians have low fat content so they are incapable of absorbing more radiation
5. Canada, Australia, New Zealand, Russia, Switzerland, Italy, Poland, China and Belgium have adopted even stricter guidelines
6. Mobile manufacturers should provide booklets carrying warning
7. People with active medical implants should keep cellphones at least 30 cm away from their body

### III. 2 RECOMMENDATIONS TO THE GOVERNMENT OF INDIA

1. Immediately implement the 50-metre safety zone around mobile towers.
2. Separate out different service providers' mobile towers, otherwise, these tend to accumulate more power.
3. Avoid towers near educational institutions.
4. Ensure that SAR rating is provided on the front cover of the cellphone manual with warning.

5. Implement EMF monitoring systems near towers and other locations.
6. Ensure that the ICMR research setup concentrates on areas where cellphones were introduced first in India and speed up the process.
7. Tie up with countries having rich experience to evaluate the long-term effect of cellphone usage, as in other countries cellphones were introduced much earlier.
8. Ensure that companies supply necessary accessories to mobile users as a preventive action and advertise the harmful effects of cellphones strongly to the public.

#### IV. USE OF FERRITE BEADS TO BLOCK RADIO FREQUENCIES

Electronic cabling and wires, by virtue of their length-to-width ratios, are perfect natural antennas. In the presence of high-speed microprocessor signals, cables will conduct, radiate, and receive unwanted high-frequency interfering signals. Control of radio-frequency (RF) interference can be ensured by the proper placement of an insertion-loss device, such as a ferrite suppressor. Compared with alternatives such as in-line filters, onboard suppression circuits, shielded cables, and expensive filtering circuits, the high resistivity per cubic volume of ferrites stands out as the most important advantage. Ferrites have a concentrated, homogeneous magnetic structure with high permeability. They are consistently stable over time and over a wide temperature range, and provide RF suppression without high eddy-current losses.

A ferrite bead is simply a hollow bead or cylinder made of ferrite, which is a semi-magnetic substance made from iron oxide (rust) alloyed with other metals. It is most commonly used with computer cables, where it is slipped over the cable while the cable is being made, or snapped around the cable in two pieces after the cable is made. In a typical computer system, found in a home or office, you will see these "bumps" on the mouse, keyboard and monitor cables.



Fig 5 : Ferrite Bead [4]

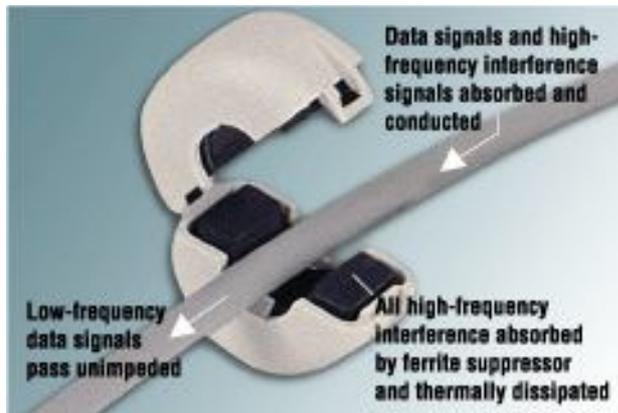


Fig: 6 A ferrite bead[4]

Using a ferrite bead to eliminate the RFI from a computer cable, or keeping it from disrupting the function of your TV, is similar to using one to help eliminate the RFI from your cell phone that may be disrupting the normal function of our brain. Thus a ferrite bead is a simple and inexpensive tool that may help you reduce your exposure to cell phone radiation.

#### IV.1 THE EFFECT OF MAGNETIC MATERIAL (FERRITE) ON A CONDUCTOR

A magnetic field will be generated when current flows through the conductor. Transfer of energy between the current and the magnetic field is affected through the inductance of the conductor used. Placing a magnetically permeable Ferrite around the conductor increases the flux density for a given magnetic field strength and therefore increases the inductance.

Ferrite permeability is controlled by the exact composition of the different oxides that make it. And its permeability is heavily dependent on frequency of current flowing through it. The ratio of inductive and resistive components of Ferrite varies with frequency. At the higher frequencies the resistive part dominates and the assembly becomes lossy, so that RF energy is dissipated in the bulk of the material and resonances with stray capacitances are avoided or damped. Impedance of the ferrite varies linearly with changes in its length and with changes in the ratio of its outer diameter to its inner diameter. To increase ferrite effectiveness select the size the inner diameter as closely to the wire size as possible. To calculate impedance characteristics of the source and load coupled with the ferrite suppressor is developed as follows:

$$\text{Insertion Loss (dB)} = 20 \log_{10} \left( \frac{Z_a + Z_b + Z_f}{Z_a + Z_b} \right)$$

where  $Z_a$  = source impedance,  $Z_b$  = load impedance, and  $Z_f$  = ferrite impedance. The ferrite is more effective when the circuit impedance is low.

#### IV. 2 INCREASING THE FERRITE EFFECTIVENESS

##### A. Ferrite Placement

For a cable, it is best to locate the suppressor ferrite bead close to the cable termination where it exits the electronic enclosure, thereby negating the cable's antenna-length effect. For circuits within an enclosure, a position close to the RF source is best; however, other locations along these relatively short runs are usually just as effective.

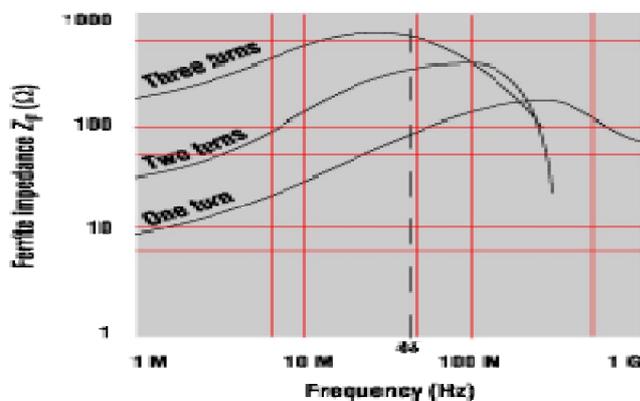


Fig: 7 Typical performance at one, two, and three turns for the same ferrite configuration [4]

##### B. Ferrite size

In applications with high circuit impedance, it may be possible to increase the effectiveness of the ferrite by increasing its impedance  $Z_f$ . However, larger ferrites, especially longer ferrites, are sometimes not an option because of space allowances, weight, aesthetics, and other packaging considerations.

##### C. Multiple looping

Pass the conductor cable through the ferrite opening multiple times by looping the cable back through the ferrite. This increases the effective magnetic path.  $Z_f$  increases geometrically by the square of the number of turns through the ferrite opening. At three or more turns, there are commensurate results



Fig: 8 A multihole ferrite core. A cable is threaded through openings in the core without passing around the exterior dimensions[4]



Fig: 9 Multiconductor flat cables can be accommodated by using a side-by-side method [4]

## V. CONCLUSION

Ferrite beads can be effectively used to limit the mobile radiation effect on human body. The performance of a ferrite suppressor is consistent over time and over a wide range of temperatures. Unwanted RF radiation can be avoided with a ferrite bead with proper matching, placement, fit, and sizing. If more suppression is required, looping the cable through the ferrite can increase the effectiveness of a ferrite without increasing cost. Multiple looping locks the ferrite into position along the longitudinal axis of the cable.

## REFERENCES

1. S. Porkodi, P. Amudha, "The Effect Of Detecting And Reducing Electromagnetic Radiation From Mobile Phones Using Ferrite Beads With Different Networks In FPGA," International Journal of Communications and Engineering, 07-May-2012.

2. Professor Girish Kumar, Electrical /engineering Department, IIT Bombay, "Cell phone/ Tower Radiation Hazards and Solutions, 2011
3. WHO/International Agency for Research on Cancer (IARC) , "IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS ," 31 May 2011
4. Jim May Vice-President of FerriShield Inc., New York City, "Filtering Out Interference Signals with Cable Ferrites".
5. Tim Williams, Elmac Services," Using ferrites for interference suppression", <http://www.elmac.co.uk/pdfs/ferrite.pdf>, 2006.
6. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface." *IEEE Transl. J. Magn. Japan*, vol. 2, pp.740-741, August 1987 [*Digests 9<sup>th</sup> Annual Conf. Magnetism Japan*, p.301, 1982]
7. M. Young, *The Technical Writer's Handbook*. Mill Valley, CA: University Science, 1989.
8. The Effect of Headset and Earphone on Reducing Electromagnetic Radiation from International Journal of Communications and Engineering. Volume 02– No.2, Issue: 04 March2012
9. Electromagnetic Frequencies. Thermal effects of Electromagnetic Radiation. [Online] available at: <http://cellphonesafety.wordpress.com/2006/07/3>
10. RF Safe. What is RF Radiation? [Online] Available at:[http://www.rfsafe.com/research/rf\\_radiation/what\\_is\\_rf/intro.htm](http://www.rfsafe.com/research/rf_radiation/what_is_rf/intro.htm)