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Analysis of Radiation Prevention Using X-Band Microwave Transmission

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Abstract

The threat and effect of radiation on humans is tremendously increasing in the recent past. This is a concept realization using a simple experimental analysis to reveal the nature and characteristics of Microwave signals. The source radiation characteristics on dielectric, humans and metal mesh acting as filter to electromagnetic waves is demonstrated with the basic microwave test bench work. The study clearly reveal that the microwaves can be restricted or prevented based on the materials used in the living area.

Keywords: Radiation, Microwave Transmission, X-Band, Electromagnetic Waves.

Introduction

The increasing radiation threats and mechanisms to minimize the cause in different environments is reported by various researchers [1-5]. The principle of electromagnetic reflection, refraction and scattering plays a vital role based on the materials upon which it falls on [5-6]. The effects of mobile station towers and sources of radiation in the mobile frequency were analyzed to determine the cause of disease threats like cancer [7-10]. EM Radiation exposure test and radiation protection test was conducted in Lab using Microwave (X-Band) test bench setup. The basic system comprised of a microwave source klystron used to generate microwaves. It is couples with an isolator that allows the wave to travel only in the forward direction. This is coupled with a variable attenuator and frequency meter. Then the device is coupled to a pyramidal horn antenna transmitter and receiver identical antenna unit. The receiving antenna is coupled with a power meter. The microwave signal generated in the microwave X-band is transmitted through the test bench and the analysis is initiated with the initial power radiated from the transmitter.

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Basic Setup

Figure 1 Microwave Experiment Test Bench

The test bench set up is used to generate the fundamental oscillation in microwave signals generated is measured using the power meter. The power radiated for the test bench achieved a maximum output of 2.9mW. The microwave transmitted from the transmitting antenna is received by the receiver antenna separated with various distances. The measurement set up is shown in Figure 2 (a) and (b). and the readings are tabulated in Table 1.

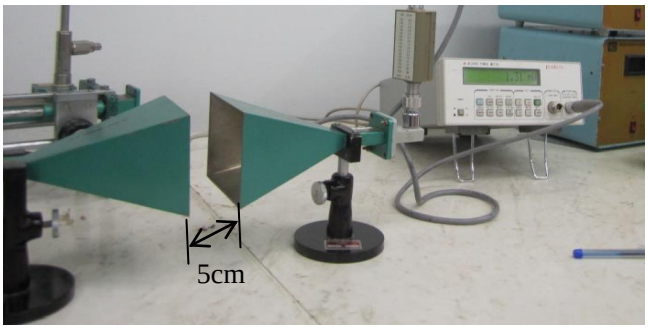

Figure 2(a) Distance 5cm

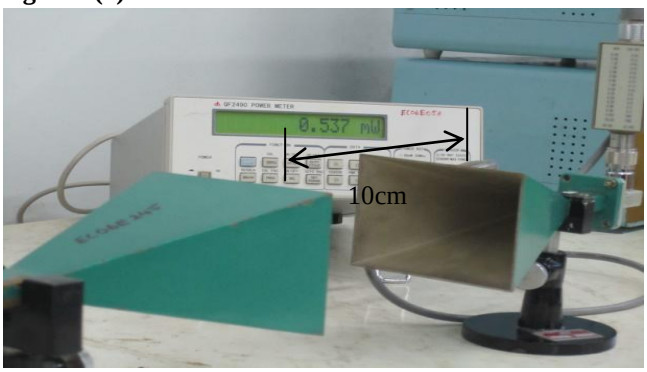

Figure 2(b) Distance 10 cm

Table 1 Power Measurement without filtering

Sl.No	*Distance (cm)*	*Power (mW)*
1	0	2.91
2	2.5	2.24
3	5	1.20
4	7.5	0.83
5	10	0.537

This power is transmitted using the pyramidal horn antenna and received with an identical antenna unit with a power of 0.2mW as shown in the Figure 2 with a separation of 5cms. The power is measured by varying the distance between the transmitting and receiving Horn antennas. Power tends to decrease with increase in Distance.

$$P \alpha 1/D \qquad (1)$$

Filter Testing

The amount of signals that is to be restricted to get received at the receiver can be achieved using an attenuator. When the EM wave is transmitted into the free space and about to be collected at the receiver with required or expected quantity the system need to use a filter. For microwave frequency a filter here is defined as an device which helps to provide attenuation to a required level or prevent the wave entering the receiver. By nature of physics any EM wave incident on to a metal surface gets reflected back normal to the plane of incidence. This mechanism is used to derive the filter system.

Dielectric Material

Figure 3 Dielectric Material

The system is tested with the presence of dielectric material acting as filter. The dielectric material made of note paper and card board of 1cm thickness is used as a filter. The characteristics of the dielectric material will reflect and refract the striking EM waves. Hence the power is reduced due to the reflection of EM waves. The microwave signal is generated by test bench is transmitted with help of a pyramidal horn antenna and the signal is received at a distance of 5cm with the help of the identical receiving horn antenna. A dielectric material is placed in between the transmission medium as shown in Figure 3. .The decrease in output power from 0.5mW to 0.272mW is observed in the power meter. This shows the reflection and refraction characteristics of the EM waves.

Body Tissue

In this technique, human hand is used as the filter. In this case the power of EM waves will decrease dramatically from 0.5mW to 9.75µW as shown in Figure 6.3. Decrease in power is due to the factor of reflection and absorption phenomena of body tissues. This also proves the human body is affected by the EM waves i.e., Mobile radiation (Signals of mobiles is EM waves). Due to factor of absorption of EM waves, the body temperature increases dramatically.

Figure 4 Human Hand Filtering Effect

Mesh Filtering

The reflection phenomenon tells and proves that the perfect conductor does not allow the EM waves to pass through it. The Conductor (Metal) will reflect the signal based on the strength of material. Density of the material α1/strength of the signal

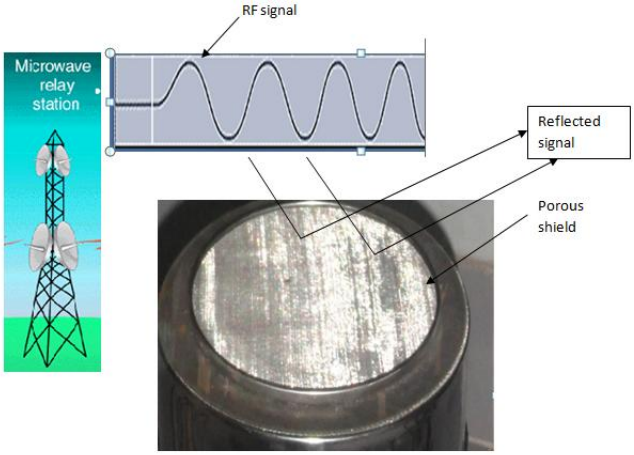

Figure 5 Basic principle of perfect conductor

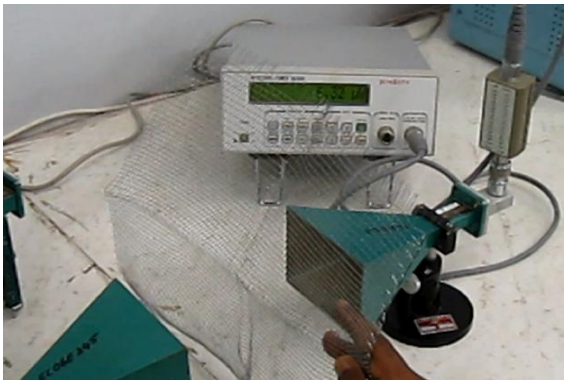

Figure 6 Mesh filtering **(a)** Single Layer 0.5mm mesh

(b) Double Layer 0.5mm mesh

In this testing 0.5cm mesh is used. RF filter is placed in between the horn antennas as the filtering material the output power decreases dramatically from 0.5mW to 6.32 µW. Figure 6. (a) shows the filtering of the power with a single layer metal mesh 0.5mm diameter. Similarly the mesh is folded to get better attenuation, in this case the output changes to a negative value (0.11µW) as shown in Figure 6 (b). Double layer filter attenuates the total power of the EM waves, whereas single allows a very tiny amount of signal to get refracted. The various testing results using different materials are tabulated in Table 2.

Table 2 Power Measurement with Filtering

Sl.No	Filter Type	Free space power (mW)	Distance (cm)	Filtered Power (mW)
1	Dielectric (note)	0.537	10	0.272
2	Dielectric (tissue)	0.537	10	0.00975
3	Conductor (Mesh) Single layer (0.5cm)	0.537	10	0.00632
4	Conductor (Mesh) Double layer (0.5cm)	0.537	10	-0.00011
5	Conductor (Mesh) (1 cm)	0.537	10	0.0254
6	Conductor (Mesh) (0.2cm)	0.537	10	-0.00016

Conclusion

Thus this project provides a radiation free modern world if suitable protective filters are installed in the living areas. It is clear that we can reduce the radiation levels inside the houses, offices and other buildings. Therefore the threats as such reported in literatures causing Cancer can be controlled by this simple mechanism used in this project. The concept can be developed further by increasing the range of controller to provide more prevention. By implementing this we can try to live in a radiation free world.

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