A GENERALISED SOFTWARE FOR DESIGNING THE OPTIMUM E.M. SHIELDS TO PROTECT BIO-OBJECTS.

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ABSTRACT

Shielding is the primary means of protection of victim devices including bio-objects. When the source of interference cannot be controlled, then any one of the three means of shielding. i.e. 1>Spatial separation, 2>Orthogonalization, 3>Metal barrier, may be used. The authors have selected the last one i.e. metal barrier. A shield does not require control of the emitter and coupling. In this paper generalized software for designing shields has been presented. Each time any electromagnetic wave strikes impedance disconductivity1>A part of its energy passes through the discontinuity and 2>rest of its energy is reflected out side and inside.

A part of the energy of the incident wave enters the discontinuity material. Some energy is attenuated in it. This attenuation is related to skin depth and is called absorption loss (A). At the first discontinuity a part of incident energy is reflected (R). At the second discontinuity a part of energy is reflected back to the first discontinuity and this process continues. So multiple reflections occur. A first correction term corresponding to that comes into the shielding effectiveness. This is B.

When absorption loss is greater than 15dB then B may be ignored.
When the source is at a large distance from the shield in comparison with the aperture spacing then a correction factor comes in S.E. This is K1.Another correction term comes in S.E. This is due to the skin depth and termed as K2.A third correction term K3 appear with S.E. when the apertures in the shield are closely spaced and the depth of opening is small compared to the distance between the adjacent holes.

So the shielding effectiveness is S.E. =R+A+B+K1+K2+K3 dB.
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K1 should be considered when source is far from the shield.
K2 should be added when skin depth and diameter of screening wire or distance between the apertures are comparable.
K3 should be taken for small opening.

Nowadays biological objects reside within the invisible net of electromagnetic fields. This may cause thermal and non thermal ill effects on the bio objects Audio, radio, microwave and even low frequency electromagnetic fields cause flow of currents through human bodies. The currents may be of two types: I) Conduction current & (ii) Displacement current.

Some of the parts of human body inside skin is conductor by nature. But human body contains water and other materials which may be considered as imperfect dielectrics. The conduction and displacement currents transform electromagnetic energy into heat. So, the temperature of human body rises, because heat generated is more than heat released. Transparent tissues, i.e. eyes, have less capacity of heat – dissipation. Again, the thermal injuries develop in the eye due to RF exposure are irreversible. Increase in temperature causes cell mitosis. This in turn causes increase in power and formation of cataract.

In the testis rise in temperature damages the cells. Production of androgen becomes less at higher temperature. Pituitary gonadal system suffers from disturbance for men or women exposed to RF radiation. Hence properly designed shields are essential for persons falling in the controlled and uncontrolled groups. In this paper at the output design-data will be available corresponding to the values of input fields and required S.E .For nested shields the mass must be considered. The procedure of dynamic programming has been adopted for optimization between the mass of the shield and required shielding effectiveness.

The composite or nested shields have been designed at different frequencies from 500 KHz to 5000MHz.The first layer was aluminum (conductivity related to copper is 0.61 and permeability is 1). The second layer was stainless steel (conductivity related to copper is 0.02 and permeability is 1000) Different combinations of thick nesses have been taken. The theoretically obtained shielding effectiveness was compared with the practical result for each case.

The experimental results are 90%of the theoretical values.