SocioBrains

ISSN 2367-5721 (online), JOURNAL HOMEPAGE: WWW.SOCIOBRAINS.COM
Publisher: SMART IDEAS – WISE DECISIONS, Ltd., Sofia, Bulgaria

ISSUE 89, JANUARY 2022

PROTECTION AGAINST THE ELECTROMAGNETIC STRENGTH OF THE RADIO WAVES IN COMMUNICATION RADIO NETWORKS

Abstract: In this paper presents protection methods against Electromagnetic straight of the radio waves in communication radio networks. Examples of personal protective equipment for monitoring EMF when working near transmitting devices. Personal Monitor. When an electric current flows through the human body, cells and tissues prevent the movement of charged particles. The value of the resistance depends on the type and condition of the cells, the value and frequency of the applied voltage and the duration.

Author information:

Dragomir Vasilev
Konstantin Preslavsky – University of Shumen
✉ d.vasilev@shu.bg
Bulgaria

Keywords:
Electromagnetic field, Electromagnetic Environment, Personal Monitor, Induction values, EF Strengths.

Introduction

EMF due to radio frequency radiation are widely used in industry, technology, transport, medicine and everyday life. A large number of specialists and workers who are in contact with EMF are involved in the maintenance of stations, sources of radio frequencies. The population living near radar stations, radio and television repeaters and base stations is also exposed to electromagnetic fields generated by the transmission of radio frequencies. The means of protection of workers in each case are selected taking into account the operating frequency range, the nature of the work performed and the required degree of protection. [1]

Exposition

The most accessible method of personnel protection is to keep a distance from EMF sources. Radio and television transmitters, radio stations, powerful microwave generators, microwave complexes, physiotherapy devices with microwave therapy, UHF transmitters with power over 100 W are located in separate shielded rooms. At the same time, if necessary, the placement of measuring instruments, low-power radio transmitters, operation in the range of the radiation flow is allowed, provided that the values of the parameters do not exceed the values for safe operation.

When placing several field sources in the radio frequency range in one room, their location must exclude the possibility that the total field strength must not exceed the permissible values for safe operation. *r,* from the workplace to the radiation source in the ranges of long, medium and short waves can be determined using the expression

(1) $$r \geq \frac{\sqrt{30PK_a}}{E},$$

where E is the allowable value of the electrical component of the EMF, V/m; *P* - average transmitter output power, W; K_a is the antenna gain.

For decimeter, centimeter and millimeter waves, the allowable distance is

(2) $$r = \sqrt{\frac{PK_a}{4\pi EFD}},$$

where energy flux density EFD is the allowable value of EFD, W/m2.

Workplaces, installations, sites, zones, territories and places of possible presence of people where EFD exceeds 500 μW / cm2, are marked with the prohibition sign “Microwave radiation. Entry prohibited.

In places where EFD is higher than 1000 μW/cm2, must be marked “Caution! Microwave radiation hazard ". At the entrance to the area where the EFD is more than 1000 μW / cm2, together with the warning signs, access must be absolutely forbidden, requiring the use of personal protective equipment when performing work.

At the same time, the levels of exposure of body parts to EMF should not exceed 10 μW / cm2.

The forms of application of protective measures are determined by the types of emissions and the purposes of the EMF sources. Thus, in the fields of high-frequency heat treatment of materials (induction and dielectric heating), the protection of personnel is carried out by shielding the high-frequency installation or its individual units (generators, capacitors, high-frequency transformers). The materials, dimensions and constructions of the screens are determined by the peculiarities of the technological process and the characteristics of the shielded unit, the required efficiency and the admissible energy losses in the screen. The screens must be securely grounded and have an electrical interlock, which excludes the inclusion of voltage when removing the screen. The high-frequency lines for energy transmission from the generators to the operating elements are realized by means of a coaxial cable. Whenever possible, the operations of the production process are automated.

In the control rooms of radio and television repeaters, the reduction of EF intensity and energy flux density at workplaces is achieved by rational placement of separate high-frequency modules in workplaces, shielding of transmitters, power lines, individual workstations or separate parts of buildings, the use of coaxial lines for energy transmission and the removal of jobs from sources. EMF broadcasting and organization of remote control of transmitters.

In the areas of regulation, adjustment, testing of microwave modules, microwave generators and microwave equipment complexes, the protection of workers is provided by switching off or limiting the operation of radio equipment in rooms with antenna radiation or open waveguide, shielding of the radiation source or working places using warning alarms and personal protective equipment. When processing microwave generators and the high frequency part of the radar, the elimination or limitation of the radiation from the antenna systems is ensured by using powerful absorbers (antenna equivalent) instead of open emitters. The verification of the operation of receiving, indicator, calculation, control and similar radar systems is performed with the help of target simulators (low power sources, generating radiation with the same parameters as the tested radar). The processing of power lines and antenna devices (waveguide connectors, attenuators, power dividers) and adjustment of the antenna waveguide paths are performed mainly with the help of measuring generators.

The height of the antennas is chosen taking into account their vertical radiation pattern. When screens are used, they are installed either near the transmitting antennas or directly next to the protected objects. In the first case, the possibility of distortion of the radiation pattern from metal surfaces is taken into account. Solid or perforated sheets and grids are used as screens.

If it is necessary to work in the area of radiation of the antennas with an intensity of EF exceeding the permissible values, the use of protective screens, personal protective equipment and

protective clothing is a mandatory condition. The organizational measures include a ban on the operation of radio equipment in open form, a restriction on the time of stay or a ban on the presence of bystanders. [2], [3]

An example of personal protective equipment for monitoring EMF when working near transmitting devices is WaveMon Personal Monitor.

STATIC FIELD DETECTION 0 Hz - Isotropic hall effect sensor
LOW FREQUENCY DETECTION 10 Hz to 400 kHz - Isotropic coil-based sensor
ACCORDING TO ICNIRP GUIDELINES For general public and occupational exposure
EXPOSIMETER WITH DATALOGGER Data collecting and Reporting
GPS AND ALTIMETER Geolocation of measurements
HIGH INTENSITY AUDIBLE, VISIBLE AND VIBRATORY ALARM With user definable trigger threshold
USB COMMUNICATION PORT Data downloading, set-up and battery charging

MAIN CHARACTERISTICS OF THE WAVEMON LF-400

- Conforms to international electromagnetic field safety standards
- H/B-field measurements from 0 Hz to 400 kHz
- Isotropic sensors
- Weighted response for direct comparison with the standard limit
- User-configurable alarms
- High intensity audible, visible and vibration alarms

- Customisable alarm threshold
- Optional GPS and altimeter
- Datalogger to report and record data
- USB for PC connection to parameterise and download data
- Small and lightweight
- Powered by 2 standard disposable or rechargeable (via USB port) batteries

Technical Specifications

Sensor type	Isotropic, RMS diode technology	
Response	Shaped (ICNIRP 1998/2020, Directive 2013/35/EU, FCC and Safety Code 6)	
Interface	1 button ON/OFF, status and low battery LED	
Indicators	6 LEDs + Audio + Vibration	
Alarm threshold	2 limits adjustable by user	
Connectivity	Waterproof USB (for downloading data and recharging)	
Falling detection	Yes	
Autonomy	> 1 month (at 8 h/day, 5 days/week)	
Data logger	> 1 000 000 events	
Positioning	GPS and Altimeter	
Logging Interval	1 second to 60 minutes (adjustable by user)	
Averaging Interval	1 second to 60 minutes (adjustable by user)	
Battery Type	2 x AA NiMH battery rechargeable by USB	
Protection	IP 54	
LF inmunity (50 – 60 Hz)	> 30 kV/m	
Temperature range	-20 / +50 °C (-4 / +122 °F) – Charging: 0 / +40 °C (+32 / + 104 °F)	
Size	174 x 42.5 x 33 mm (6.8 x 1.7 x 1.3")	
Weight	190 g (6.7 oz.)	
	E-field	H-field
Dynamic range	1 – 300 %	2 – 300 %
Linearity	±0.5 dB (2% – 200%)	±1 dB (5% – 200%)
Isotropic deviation	±1 dB @ 1GHz	±1 dB @ 400 MHz

WaveMon Version Selection Table

		Frequency range and response	
Versions	Response shaped to	E-field	H-field
WaveMon RF-8 ICN WaveMon RF-8 EUD	ICNIRP EU Directive 2013/35	300 kHz – 8 GHz ±3.5 dB	25 MHz – 1 GHz ±1 dB (30 MHz – 700 MHz) +0 dB / -2.5 dB (700 MHz – 850 MHz) +0 dB / -5 dB (850 MHz – 1 GHz)
WaveMon RF-8 FCC	FCC	3 MHz – 8 GHz ±3.5 dB	3 MHz – 1 GHz ±1 dB (3 MHz – 400 MHz) ±2 dB (400 MHz – 850 MHz) +0 dB / -4 dB (500 MHz – 1 GHz)
WaveMon RF-8 SC6	Safety Code 6	10 MHz – 8 GHz ±3.5 dB	25 MHz – 1GHz ±2 dB (30 MHz – 800 MHz) +0 dB / -5 dB (800 MHz – 1 GHz)

The WaveMon LF-400 is a low frequency exposimeter that has a datalogger for continuous data recording. Communication with the device is through a USB port that allows you to configure the

device and download the recorded data. This makes it easy to create reports and allows you to keep a record of your exposure data for your safety. It have created an accessory that allows you to attach the personal monitor to your harness, arm or belt and so take it in hand to hold it near a radiation source and then put it back in place easily and can also secure it with a small carabiner so that it won't be dropped. The device is small and lightweight and works with AA batteries that can be recharged via the USB port. It can also use standard AA batteries, so that they can always be easily replaced. The WaveMon is the only personal monitor equipped with a GPS and Altimeter for geolocation of measurements. As an example, in a high voltage tower, the GPS will provide the geographical position of the tower and the Altimeter the relative height from the ground. Over-exposure alarms can be configured from a PC using the USB connection.

Two different alarms can be programmed and personalised separately for each of the standards: General Public and Occupational. The alarm level (% of the selected limit) and the type of alarm (sound, vibration or both) can be set-up [5]

Conclusion

A noticeable thermal reaction of the human body to the EMF effect occurs when the value exceeds 10 mW / cm2. When determining the directional patterns of the antennas, directional branches, power dividers, attenuating waveguides are used to connect the stations to the antennas. A smaller part of the power enters the antenna, a large part is absorbed by the waveguide is redirected to the power absorber. The shielding of radiation sources or workplaces is done with the help of reflective and absorbing screens. [4]

References:

1. Ellis, F. P. et al., Physiological Responses to Hot Environments; special report, Series No. 298. Medical Research Council, London
2. Code of Practice – Masts and aerials, B5248 UK Dept. of the Environment.
3. Adair, E. R., Thermophysical Effects of Electromagnetic Radiation; IEEE Engineering in Medicine and Biology Magazine, March 1987
4. Buzov AL, Kolchugin Yu. I., Paltsev Yu. P. Ecological aspects of EMI of mobile stations of mobile communication systems // Occupational medicine and industry. ecology. - 1996
5. WaveMon_Datasheet_EN