

# Existence of Electromagnetic Radiation in Humans in ELF Band

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## Abstract

Submitted report is oriented to the area of detection of signals emanated by Man in the ELF - Extremely Low Frequencies range. Designed and applied antenna system suitable for signal reception in the ELF band is presented here. Results of digital signal processing in the ELF band are presented in the report in the graphic form together with the photographic material provided in the course of signal recording. Finally, there is discussion of possibilities of the ELF band signal analysis for detection of men - for example under the snow avalanche, in cave-in in underground mines, etc.

## 1. Introduction

Every living organism on our planet is surrounded with energy in form of the signal environment. This energy is produced either by him as result of essence of his living and survival, or the energy occurs in form of natural and artificial signals of the terrestrial origin and further of extraterrestrial origin, signals coming from the near and deep space. If Man has the option, the gift to see far broader spectrum, so not to be limited by visible part of the spectrum only, he would be surprised, for sure, how dense spectrum exists on our planet. That magical word "energy", which is cause of everything, the word quoted in any form and connected with every living or dead form, is playing important part. There is no doubt that Man itself is emanating energy. However, it is necessary to remember how weak this field is. Signals emitted by the brain constitute one component of this energy. It concerns Extremely Low Frequencies - ELF.

## 2. Electromagnetic Field of Human Body

A cell is the basic, very small unit of the living substance. It measures about 10 microns, i.e.  $10^{-5}$  m. But, it is still enormous to compare with particles carrying electrical charge (electrons) - there is place for at least 10,000 for them on the cell length and about 30,000 for them on the cell circumference. To create electricity in the cell, the cell needs capacity to process certain chemical materials, which the cell absorbs. The cell makes free chemical energy by chemical decomposition of the material and is using it for protein building, for its own work and for creating electricity in presence of oxygen. The electricity is the most important thing for some cells, for nerve cells for example. Communication between nerve cells (neurones) depends on the parameter called resting membrane potential - RMP. Cell interior is negative in respect to its surface and potential across the plasmatic cell membrane is reaching values between -20 mV and -200 mV. The higher potential difference, the higher voltage. RMP of the nerve cell is in range -40 mV to -90 mV, the sustained value is -70 mV. We call such cells polarised. Aforesaid voltage values are really negligible; currents reach orders of magnitude of microamperes. Nevertheless, those values are not insignificant.

### 2.1. Schumann Resonance - Connection of Man with the Nature

It concerns the state on boundary of beta and theta levels, at 7.83 Hz more precisely. Brain waves have no constant frequency, but their frequency is changing. The whole control system is buried deeply in the brain, in the thalamus. The thalamus is switching and integrating center of excitements coming from sensors, from the spinal cord and the brain stem to the cerebral cortex. The system is called thalamic rhythmic generator or "pacemaker". Calcium ions are seeping slowly to particular thalami-cortical neurones, which are oscillating 1.528 sec and are triggering brain waves. Then, the brain waves propagate up to the cerebral cortex. If those neurones are saturated with calcium ions, the thalamic oscillations stop. The brain waves are "idling" during this "silent phase", lasting from 5 to 25 seconds. The thalamic oscillations start again, when the calcium level in cells drops to the value allowing the neurone to oscillate again. EEG has shown that waves do not expand to the brain only, but through the whole nervous system (through the perineural system) and to every part of the organism. So, the brain waves adjust sensitivity and activity of the whole nervous system. The time domain, where the brain waves are not thalamus controlled is the most interesting part of the system. Then

the brain field can be affected by electrical and magnetic rhythms from outside, natural or artificial. Magnetic field of Earth (geomagnetic field) is reason for magnetic needle of a compass pointing to the North Pole. But, if you look to the needle under the microscope, you see its minute movement due to geomagnetic microscopic pulses, which are reason for the unique geophysical mechanism - Schumann resonance (SR). German atmospheric physician W. O. Schumann brought in the idea that the space between the Earth surface and the ionosphere behaves as the resonance cavity - energy for this cavity is supplied with thunderbolts. The Schumann theory was accepted in sixties. So, thunderbolts generate electromagnetic standing waves propagating around the globe. Those waves are reflected from the ionosphere back to the Earth surface and then back to the ionosphere. So, value of the Schumann resonance depends on the distance of the ionosphere from the Earth surface, which is subject to the Sun activity. This value is subject to the magnetic storms disturbing the ionosphere above all and the Schumann resonance trails off, so it is created by terrestrial activities and modified or modulated by extraterrestrial activities. The following correlation is interesting as well, resulting from that all - wave length. We can find out by calculation, that  $\lambda = c/f = 2.997\,924\,580 \cdot 10^8 / 7.83 = 38.3$  thousand km. This number is not accidental and it is close to the value of the Earth circumference.

### 3. Measuring Chain, Measurement of Man Emission in ELF Band

A proper antenna is the basic building element for man emission measurement in ELF band (3 - 30 Hz). Either a loop antenna used from ELF up to UHF bands from the very beginning of radio communication or large inductive coil can be used for this measurement. Both antenna types have the advantage that their sizes are relatively small comparing with the wavelength for which they are intended. The large copper quantity necessary to build the winding is their common disadvantage. In contrast to an electric monopole, these antennae are working with the magnetic field entirely and therefore it is advisable to use proper electrostatic shielding.

To compare expediency of antenna types for man emission measurement in ELF band, both above mentioned antenna types were built. The loop antenna was built first, its picture is shown on Fig.1. The antenna is wined

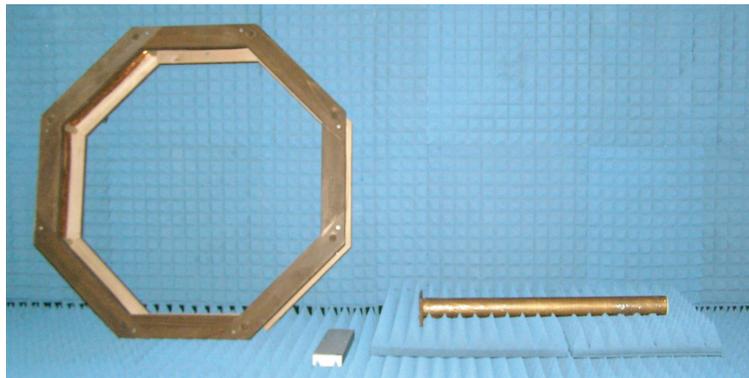


Figure 1: Functional antenna construction

on a wooden frame in the shape of the regular octagon. Length of used 1.3 mm thick copper wire was almost 500 m. The antenna was shielded with an aluminous foil and grounded. The effective aperture size is 118.3 m<sup>2</sup>, loop resistance is 5.98Ω, loop inductance is 31.2mH and the low cut-off frequency is 30.5 Hz.

The antenna of the inductive type was built as the second, its picture is on Fig.1, too. More than 40,000 turns were wound on the PVC tube with the outer diameter of 50 mm and length of 870 mm. Length of used 0.33 mm thick copper conductor was approximately 7 km. The coil resistance is 1.46kΩ. and measured inductance is 6.01H. Each of 15 layers is sandwiched with the thin insulation paper. The electrostatic shielding was provided in the same way like for the loop antenna. The coil magnetic core (filling almost whole inner space of PVC tube) was provided from annealed iron bands of different width. Impregnated insulation fabric was inserted between bands.

Signal from the antenna is fed into a current/voltage converter composed with the operation amplifier with ultra low basic noise level. Behind second stage with fixed voltage gain 45 dB, there is filtration cascade of the 8th order low-pass filter type with the corner frequency of 30 Hz. Used inverse Chebyshev approximation gives worse phase ratio, indeed. But the implemented filter has attenuation of 60 dB on 50 Hz, which is line frequency

used in the Czech Republic. Filter output signal goes to input of the digital DAT tape recorder. DAT tape recorder has built-in 16-bit A/D converter and it works with the standard 44.1kHz sampling frequency. The whole measurement chain was supplied from accumulators during recording. Man emission in ELF band was measured both in the free-field chamber located in a building in the Brno City centre and in the free terrain approximately 8 kilometers from the town agglomeration. More than 5 hours of signal recording were made gradually under situation, when a man was moving in distance 0.5 - 2.5 m from individual antennae or the man was tens of meters away from individual antennae. Then, the recording was stored in PC through SP-DIF interface, converted to the data format suitable for MATLAB software environment and then it was digitally processed.

#### 4. Analyse and Interpretation of Signal in ELF Band

There is an example of the signal time path in ELF band without man presence in Fig.2. Top diagram

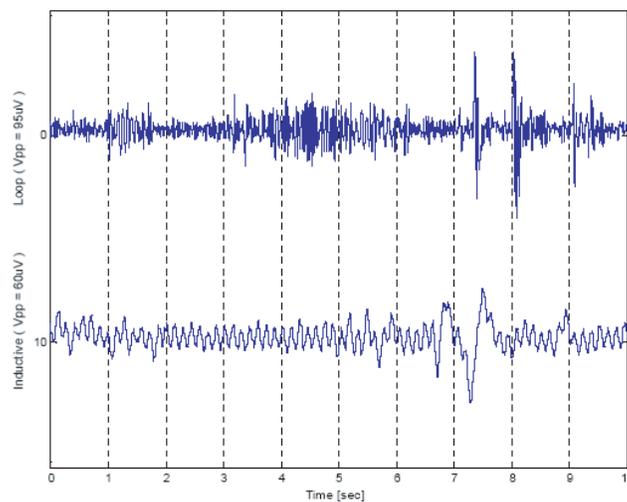


Figure 2: Time path of the recorded signal

corresponds to the loop antenna recording; the lower diagram corresponds to the inductive coil recording. Although this record was made in the screened free-field chamber, it is obvious from the time path that very strong industrial interference was present. The spectral analyse can give us more information. Well-known Welch method proved to be suitable means of the spectral analyse in the end. Smoothed out spectra diagrams corresponding to recordings from the loop antenna are shown in Fig.3, then corresponding diagram for the inductive coil is shown in Fig.4. To facilitate comparison, only two smoothed out spectra diagrams are shown in each figure, they correspond to human presence and absence in antenna proximity.

It is typical for recordings made with the loop antenna (Fig.3) that the man present is amplifying frequency components markedly near SR. In addition to this resonance, presence of the man results in appearance of other distinctive frequency peaks on frequencies in 1.3 - 4 Hz band in signal spectres, furthermore on frequency 21.2 Hz and 28.7 Hz. The peak on frequency 16.7 Hz is not mentioned because this frequency value belongs to the 15kV tractive line supply abounds in the European railway transport.

It is typical for recordings made with large inductive coil (Fig.4) that there is no visible amplification on SR frequency (6.9 Hz) caused by presence of man. It is in contrast to recordings made with the loop antenna. But, man presence is the most distinctive in 1.3 - 4 Hz band. The third most distinctive frequency peak has value of 26.8 Hz, with splitting to the frequency of 28.7 Hz. It is necessary to mention here that the inductive coil sensitivity for man presence was on its highest if oriented in east-west direction.

It can be stated generally that the inductive coil has shown better characteristics in the process of measurement. Because its size is smaller than that of the loop antenna, it is not sensitive to wind gusts and it appears to be more perspective for the future. The measurement proved that the man can be detected in the 1.3 - 30 Hz frequency band.

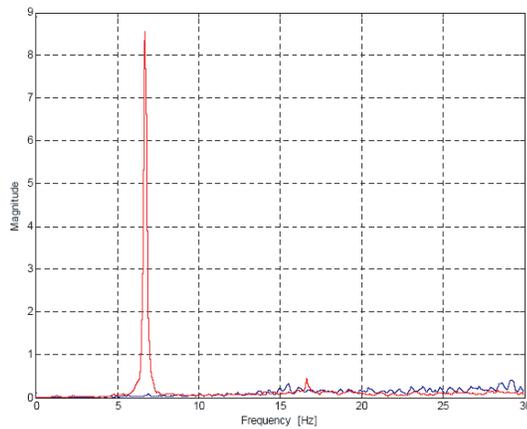


Figure 3: Smoothed out spectra diagram, the loop antenna is used (Blue diagram C no man is present, red diagram C man is present)

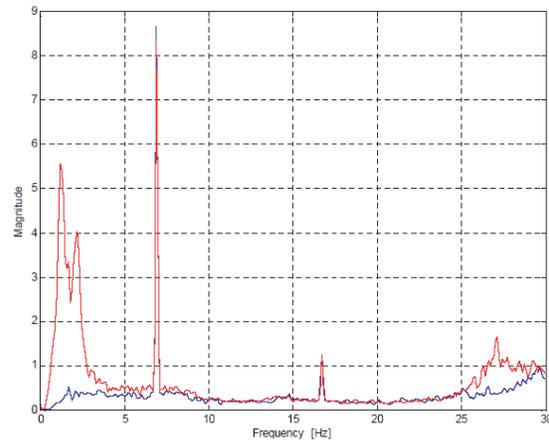


Figure 4: Smoothed out spectra diagram, the inductive coil is used (Blue diagram C no man is present, red diagram C man is present)

### Conclusion

This paper reports the measurement of the radiation from humans in ELF band using two types of antennas. A briefly analysis of the measured spectra diagrams is made and consequently a conclusion is made that man is emitting EM energy in the band of interest. This band was situated deliberately to the frequency interval of 0.5 - 30 Hz. In the following works, it is necessary to optimize antenna aperture size from the point of view of reasonable dimensions and to carry on set of measurements allowing detection of the human body imprisoned under the snow avalanche, for example. However, design and construction of ELF band antenna with the distinct directional characteristic is the necessary assumption, in order that other people in vicinity do not influence measuring results. Design of antenna system form is subject of research of this problem as well. Question arises, too, if it is advantageous to design the dedicated loop or inductive antenna with the free resonance frequency on 1 - 7 Hz approximately. Considering supposed applications, only magnetic component of the emission was recorded and analysed yet. Nevertheless, works on measurement and recording of electrical human body emission component are in stage of already designed dedicated measurement devices.

Results of future research of this certainly interesting problem will be presented.

The submitted report should be understood as inspiration. Authors are open to any motivating suggestions and opinions from expert community.

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