School experiments with a high frequency electromagnetic fields analyzer HF35C

Analyzer HF35C

The analyzer HF 35C (figure 1) allows a competent assessment of high frequency exposures between 800 MHz and 2,5 GHz. From a building biology perspective, this particular frequency range is especially relevant because mobile phones (e.g. GSM800, GSM1900, TDMA, CDMA, AMPS, iDEN), cordless phones (2,4 GHz), microwave ovens (2,45 GHz), as well as next generation technologies such as UMTS (3G) or Bluetooth all make extensive use of .

Figure 1. Analyzer HF35C.

The analyzer HF35C consists of a basis measuring device and sensor (figure 1). The sensor of HF radiation is logarithmic-periodic antenna. It has an exceptional directionality. Thus it becomes possible to reliably locate or "target" specific emission sources in order to determine their contribution to the total HF radiation level. To know exactly the direction from where a given radiation source originates is a fundamental prerequisite for effective shielding.

The values shown on the display always reflect the power density S in $\mu W/m^2$ of the ambient levels in reference to the spatial integral of the "antenna lobe", that is to the direction the antenna is pointing towards. Switch for selecting measurement ranges allows: 199,9 $\mu W/m^2$ (*fine*), 1999 $\mu W/m^2$.

Experimental assignments

(a) First group:

- Determine the power density *S* of EMF *outside* your flat and school.
- Determine the power density *S* of EMF *inside* your flat and classroom.

(b) Second group:

- Determine the power density *S* of EMF in the surrounding of microwave oven.
- Determine the power density *S* of EMF in the surrounding of cordless phone.
- Determine the power density *S* of EMF in the surrounding of mobile phone.
- Determine the power density *S* of EMF in the surrounding of wifi transmitter.
- Analyze the measured values of power density *S* and compare them with standards.

Experimental methods

When testing for HF EMF exposure levels record individual measurement on a data sheet. Later this will allow to get a better idea of the whole situation.

(a) Outside and inside

Outside: Move slowly in the surrounding of your house and school and observe the digital display of the analyzer in your hand. Rotate your hand in different directions. Try to find the power densities *S* at some places.

Inside: Repeat the same procedure as mentioned above in the different rooms of your flat and at school (e.g. in your classroom and study of your teacher). During these measurements all the equipment using HF EMF are switched off. Try to find the sources of EMF, if they exist. If you do not find any special source of EMF, measure *S* inside some rooms of your flat, inside your classroom and study. The measuring positions choose on the basis of qualitative experiments. Antenna of analyzer is oriented to the window.

Then open the window, poke out (don't get off the window!) and measure *S* approximately 0,5 m in front of each window in rooms, classroom and study.

(b1) Microwave oven

First warning! Microwave oven (MWO) should not be operated when empty. Before each experiment insert in the cooking space containers with circa 0,5 l (1l=1dm^3) of water and close the door of MWO.

Experiment with MWO realize in two steps:

Step 1: Qualitative experiments. First, use microwave leakage detector MW1AK or MT-128, figure 2, then HF analyzer FH35C. MW1AK (or MT-128) detects microwave leakage around doors and fittings on MWO. It is designed for domestic use, not for laboratory or scientific work [8].

Figure 2. Microwave oven in the kitchen and MW1AK (on the left) and MT-128 (on the right) microwave detectors.

With MWO on, hold black end of probe and move white tip against the seams and seals of the oven. While moving probe slowly, observe the needle located on the detector meter. If the needle remains in the green zone of the meter, little or no leakage of microwave energy is detected. But if the needle is in the yellow zone, it is recommended that the microwave oven be inspected by an authorized service agency [8].

If MWO is in good order, continue experiment with HF analyzer. With MWO on, hold the HF analyzer in front of you and move in the kitchen with antenna oriented to MWO. While moving slowly near and far from MWO observe the digital display. On the basis of the experiment determine at least four measuring positions. You can choose the places where you and your family members spend more time, e.g. the places in the kitchen where you are sitting around the table and in front of gas cooker. Draw the ground plan of the kitchen. Label the position of MWO and positions of chosen measurement points.

Step 2: Quantitative experiments. Measure the time dependences of power density *S* at the chosen positions. You need three pupils. First pupil holds the HF analyzer tight in the position e.g. point A at a height of 1,60 m above the floor. It is MWO height about the floor. Antenna

is oriented to MWO. Second pupil starts video measurements of the display of HF analyzer. The third person switches on the MWO for e.g. 60 seconds.

Repeat the same procedure at the next chosen positions. Later on save videos in computer and analyze the data using table calculator e.g. Excell.

Analysis of video: Start video. Stop video at some regular time intervals and read time (t) in seconds and power density (S) in $\mu W/m^2$. Couples of (t_i, S_i) insert in table calculator and draw the graphs, $S = f(t)$.

Compare the measured values with standards.

The shielding property of MWO coat (**Warning:** MWO is off during this experiment):

First: Insert the switched-off mobile phone in the switched-off MWO. Close the MWO door. Try to call to MPH placed in MWO and listen if it starts to ring.

Second: Insert the ringing MPH in switched off MWO. Close the door and measure the S in the surrounding the MWO.

(b2) Cordless and Mobile phone

Cordless phone: First - realize qualitative experiments in the room with cordless phone (CPH) in stand by mode, figure 3. Second - draw the ground plan of the room and on the basis of qualitative experiments choose the measuring positions e.g. the places where people spend more time. Third - realize quantitative experiments in chosen points.

Figure 3. Cordless phone.

Mobile phone: Realize measurements in two steps.

Step 1: Qualitative experiments. Switch on the mobile phone (MPH), and put it on the desk (no ringing). While moving analyzer slowly, near and far from MPH, observe the display located on the equipment. Repeat the same procedure while ringing, and also while telephoning. Describe qualitatively the distribution of EMF around the MPH (e.g. at display and at back side of MPH).

Step 2: Quantitative experiments. Put the HF analyzer and MPH on the desk. Its distance is e.g. 0,50 m. The MPH is in vertical location and its display is oriented toward the analyzer. Switch range of analyzer to peak value. First start video measurement of the analyzer display, than start to call somebody (only ringing, nobody answers). Stop video after time interval e.g. 60 seconds.

Then turn mobile phone round its vertical axis (180°), to direct back side of mobile phone to analyzer and repeat the measurement.

Analyze measured results using computer, like in MWO case. Draw the graph, $S = f(t)$. Compare the results with standards.

(b3) Wifi

Find out if your school has wireless connection to Internet. You can ask your teacher or the presence of wifi (wireless fidelity) network can be detected qualitatively using equipment called W-LAN finder, figure 4.

Using HF analyzer determine power density S in the surrounding of the wifi transmitter, figure 5, and in the surrounding of notebook when its wifi is switched on. Notebook is receiver and emitter of HF radiation when its wifi is switch on. His antenna is placed alongside of screen. Compare the measured results with standards.

Figure 4.
W-LAN

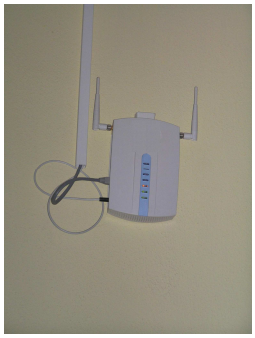

Figure 5.
Wifi transmiter.