

## **Compact and lightweight VLF/LF magnetic antenna with femtotesla noise level**

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The measurements of the electromagnetic field in the frequency band 3-300 kHz are widely used for subsurface geophysical surveys, investigations of the various phenomena in the Earth-ionosphere cavity, in the ionosphere and in the magnetosphere, including those connected with seismic and lightning activity.

The instrumental noise has to be as low as possible in order to reliably detect the weakest electromagnetic signals, which magnitude could be only a few femtoteslas.

In order to decrease magnetic antenna noises the size and mass of the probe has to be increased. However, such approach could be hardly applied for development of mobile sensors. In this report the efforts to achieve the minimal possible noise level at the restricted weight and size of the magnetic antenna are presented.

Applying the minimal mass criteria the noise level of the induction coil with a high permeability magnetic core, used as a probe, was optimized. The new pre-amplifier, based on the ultra low noise field effect transistor, was developed. The special attention was paid to the design of the electrostatic screen, which has to generate negligible magnetic noise.

As a result, the 300 mm long, 25 mm diameter antenna has the noise level approximately 1 fT/sqrt(Hz) in the frequency band 50 – 200 kHz and <5 fT/sqrt(Hz) in the band 3 – 500 kHz. The mass of the antenna is equal to 0.27 kg for the weather protected version and 0.15 kg for the indoor version.

The possibilities to achieve even lower noise level at the same size of the instrument will be also discussed.