UK Radio Astronomy Association

E-Field Antenna Installation

Using the Antenna

Having built a simple antenna enclosure as described in my previous note (E-Field Probe Antenna Enclosure) the next step was to see how well the E-field antenna worked to observe VLF signals. This note looks at how best to position the antenna for good reception.

The testing I was able to carry was qualitative and based on simple observations using a PC soundcard and Spectrum Lab software. My objective was to see if the antenna would work indoors or whether it was essential to mount it outdoors on an isolated pole as described in Dave Powis's original description.

How it Works

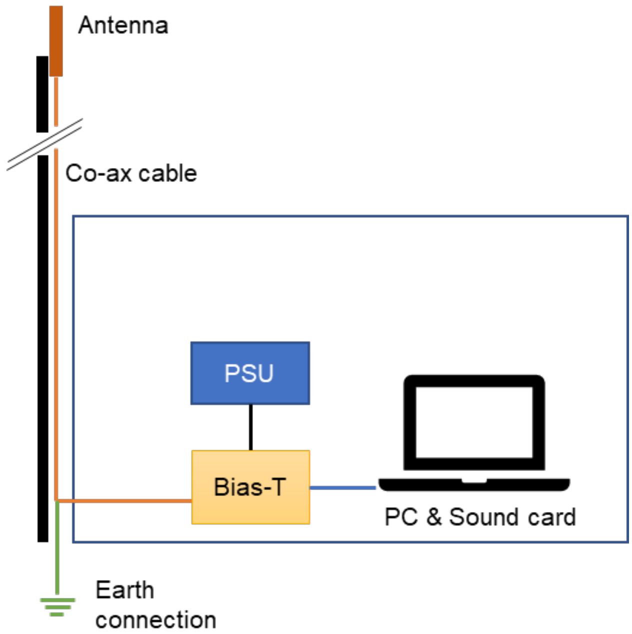
An E-field probe measures the electrical field between the antenna and earth. It can be envisaged as a volt meter measuring the electric field strength of a radio signal. A radio wave has a magnetic and electric field component. The magnetic field will induce a voltage into the wire of a conventional wound antenna while the e-field can be measured with a "volt meter". The electric field is measured in volts per metre (V/m). Near to a powerful transmitter this will be tens of V/m while at a distant receiver the field will have fallen to microvolts/m. The top end of the e-field antenna is one probe and the earth connection is the other probe of the voltmeter. The electric field voltage is proportional to the separation between the probes. Therefore the greater the distance between the antenna and earth the better the installation should work.

There is a very good explanation of the theory of the e-field probe and active antennas on-line on Pieter-Tjerk de Boer's (PA3FWM) excellent website, see https://www.pa3fwm.nl/technotes/tn07.html.

Connecting the Antenna

The antenna needs a power supply between 12-15Vdc. The Bias-T feeds power to the antenna while isolating the receiver from dc voltage. An earth is needed near where the feeder cable from the antenna connects to the Bias -T. Ideally this would be where the feeder enters the building. This earth point is one terminal of the voltmeter and the antenna is the other. The greater the separation between these points the better. An earth at this point will also provide some protection to the PC from induced voltages. The UKRAA 15V power supply is suitable for powering the antenna using appropriate connectors.

It is good practice to leave a strain relief loop under the antenna and support the weigh of the co-ax cable with tie wraps. Also make a drip loop where the cable enters a building to prevent water tracking along the cable and damaging the Bias-T.

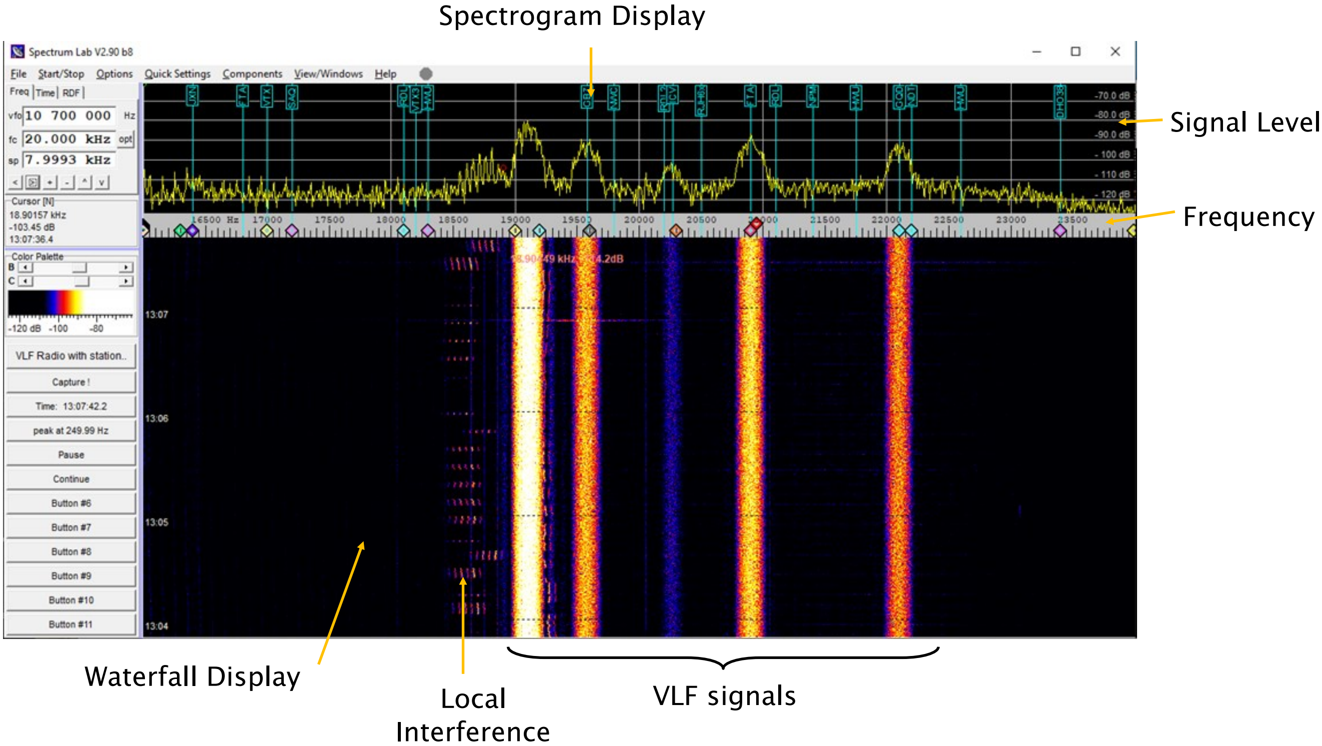


Viewing the Output Signal

My interest is in observing the effect of solar flares on the Earth's ionosphere as Sudden Ionospheric Disturbances (SID) which monitors transmitters in the VLF band. These signals are within the range of a standard PC soundcard and can be visualised using SpectrumLab software. I connected the output of the Bias-T to a soundcard and displayed the output as a spectrogram. SpectrumLab is a powerful sound analysis programme written by Wolfgang Büscher (DL4YHF) and available from his website https://www.qsl.net/dl4yhf/spectra1.html.

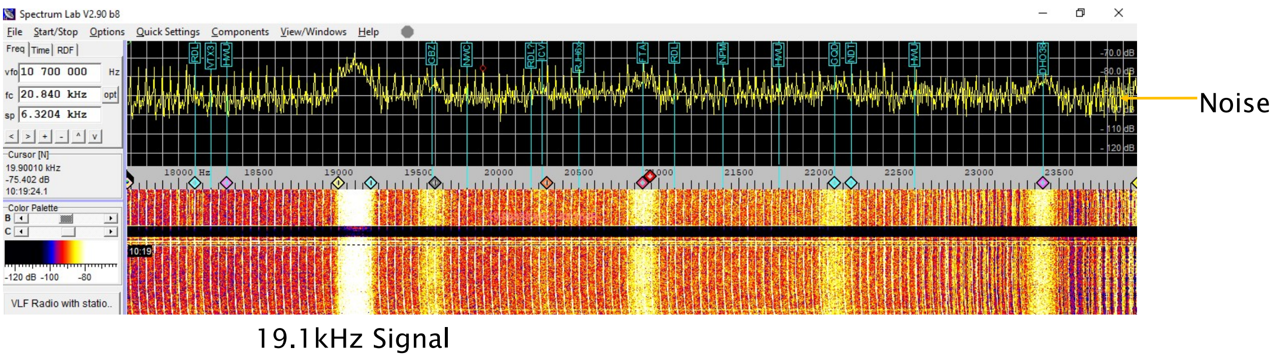
This is a powerful software and this is not the place to attempt an explanation of how to use it! The screenshot overleaf is of the main SpectrumLab window and indicates the main elements of the display.

Spectrum Lab Display



Indoor Test

My first test was to use the antenna indoors. Recalling the theory of how an e-field probe antenna works I did not expect to achieve good results. I was not disappointed. Two factors come into play, firstly there is a lot of electrical noise in a domestic setting and secondly there was only a small separation between earth and the antenna. Earthed metalwork such as water pipes, radiators, the earth in electrical wiring, is all around the antenna on the walls and in the ceiling and the loft space.



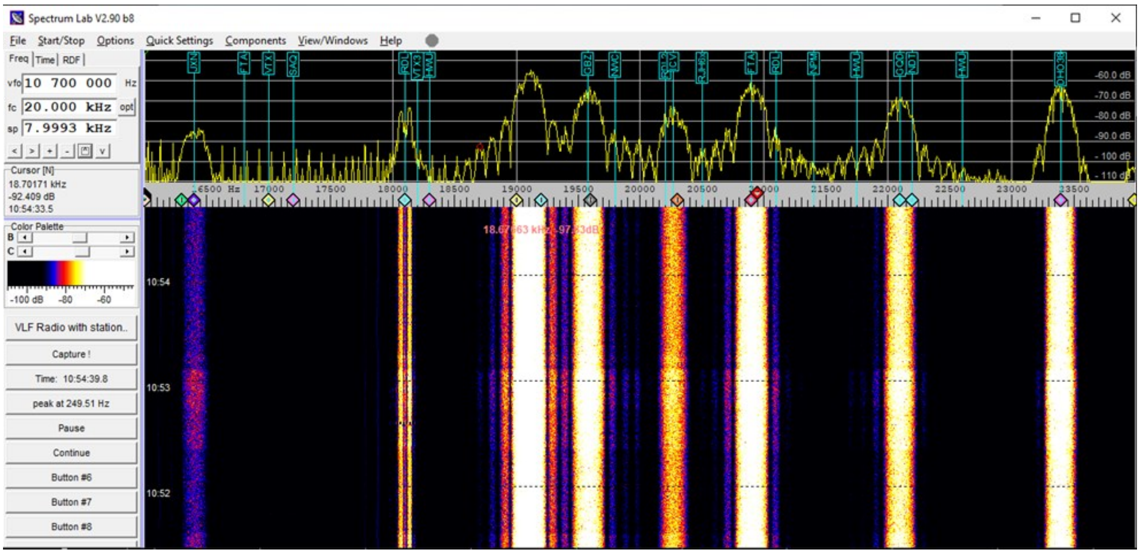
Spectrum Lab trace showing signals barely detectable above the noise.

Outdoor Test

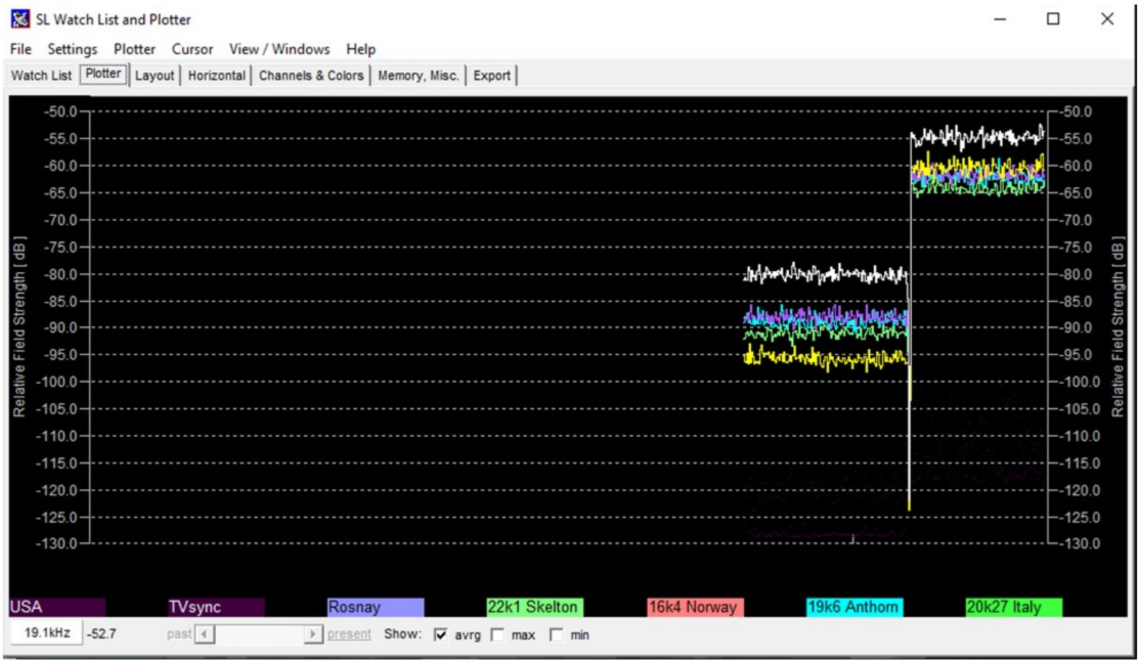
The next attempt was to install the antenna outdoors on the shed. This photograph shows the antenna enclosure fixed on a length of plastic pipe, approximately 4m above ground level. This is a temporary installation to test the antennas performance in an open environment, the supporting pipe is simply wedged behind the door!

This produced good results with strong signals observed on the spectrogram. As a comparison I used a UKRAA loop antenna connected to the sound card with the same settings on SpectrumLab. The relative signal levels for the EFP were 20-25dB higher.

SpectrumLab will produce a plot of signal level against time. In this screenshot the input is swapped from a loop antenna to the active antenna. The plot clearly shows the increase in signal level. The biggest change is to the yellow trace of the 23.4kHz signal and when changed to the active antenna its level increases significantly more that the others. This is due to the active antenna being omnidirectional while the loop antenna has null points on the axis at 90° to the loop. The antenna was orientated north-south, the bearing of the 23.4kHz signal is roughly east and it is therefore close to the null points of the loop antenna and is attenuated relative to the other signals which are on the north-south axis.



EFP Antenna Signals 19.1kHz Rosnay 19.6kHz Anthorn 20.9kHz St Assise 22.1kHz Skelton 23.4kHz Ramsloh



Signal from EFP Antenna

Signal from Loop Antenna

Conclusion

The antenna does not work well indoors due to noise and poor separation from earth. Outdoor performance was good and encourages further experimentation. The next note in this series will look at how to record the signals for SID observations.

These tests were very simple and are not a definitive assessment of the antennas performance. Individual users will have their own unique constraints on where the antenna can be installed and used. Experimentation is encouraged and I would be pleased to hear of other users' experiences, successes and failures! Please contact info@ukraa.com.

Andrew Thomas (Trustee UKRAA)—January 2020