Very Short Active Vertical Wideband Receiving Antenna. Experiments with a Capacitive Hat at MW and SW Frequencies .

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Adding a capacitive hat to a very short vertical as shown on ***Fig.1*** increases the receiving antenna current . The signal from these short verticals is picked up by a high Z input amplifier.

Models

MMANA antenna analyzer program was used (MININEC core) for all models .

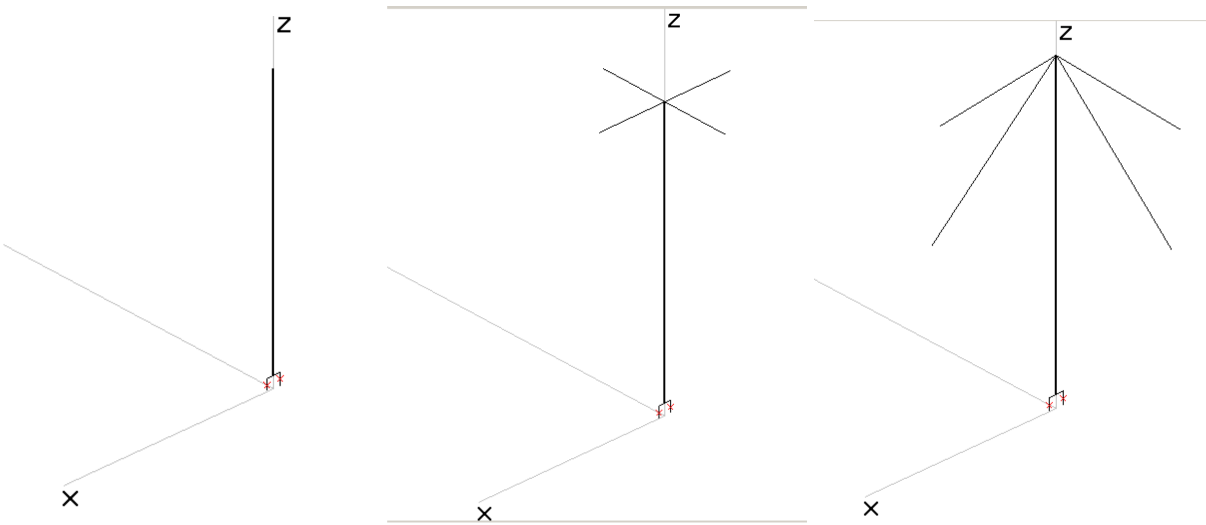

Fig.1 *Three short verticals with the same length and different capacitive hats. MMANA models.*

The basic vertical is long 1.2 m **.** The next is the same vertical with four 0.3 m horizontal hat wires. The third model is with four 0.7m sloping hat wires. The vertical is connected to the MMANA ground (ground model e=5 , s= 15) . MININEC permits to connect wires directly to ground if Z coordinate is zero. At far zone (600 m away) another vertical dipole is placed with a source which creates a homogeneous far zone field. The induced currents at each receiving antenna base are calculated and compared. The receiving antennas are loaded with 100 Kohms and 10 pF in parallel. These loads represent a typical input impedance of an active antenna amplifier.

Experiment

The experimental setup which corresponds to the models is as follows:

Vertical antenna : steel whip 1.2 m long 2 mm diam.

Ground: Metal plate 20 x 30 cm placed on the grass
Hat 1: four 0.3 m long wires horizontally placed
Hat 2: four 0.67 m long sloping wires at 45 degrees
Diameter of the wire of the capacitive hats: 0.6 mm Cu, magnet wire
Amplifier: AAA-1C in dipole mode. See the specifications in ***[2]***
Measurement Receiver: Perseus with Linrad SDR software.
Environment: A grass yard. Antenna placed 15 m away from the house. No ground rods are used. The soil has some humidity due to a rain 1 day ago. Date: July 2020, 22:00).

A small relay (TQ2 Panasonic with 0.3 pf capacitance in open state) connects the hat to the vertical. In open position the hat is disconnected and the residual capacitance is less than 0.5 pF so the vertical works without hat.

The relay was switched periodically with 1Hz frequency in order to compare the signal level with and without hat in repetitive way. The switching circuit is very small and powered by a miniature battery in order to avoid influence on the antenna behavior.

We have used real signal sources from numerous AM broadcasting and digital transmitters existing on MW and SW bands to evaluate the difference in signal levels with and without hat. This method is described elsewhere **[*1*].** This is an accurate method to compare two different antennas or antenna modes in the same time with the same source signal. The usual fading does not influence the precision of the results and +- 1 dB uncertainty can be obtained. Digital stations are best suited for this purpose since the impact of the selective fading can be diminished.

On ***Table 1*** are shown relative currents in the load compared to the current in the vertical without capacitive hat.

Antenna type	F MHz	1	3	8	15
0.3 m hat	Experimental	4	not measured	4	5
	MMANA	4.6	4.46	4.57	4.73
	C divider part	1.5	1.5	1.5	1.5
0.7 m hat	Experimental	7	7	8	9
	MMANA	8.03	8.08	8.1	8.83
	C divider part	2.3	2.3	2.3	2.3

Table 1 *Additional gain in dB compared to vertical without hat. C divider part is the gain increase due to capacitive divider effect (**Fig.2**). The experimental data are averaged values from numerous BC and digital stations with 1 dB resolution.*

Discussion.

There is an agreement between models and experimental data. The output signal from the active antenna depends on two factors. The effective height of the antenna and the input impedance of the amplifier. The very short whip source impedance is almost a pure capacitance.

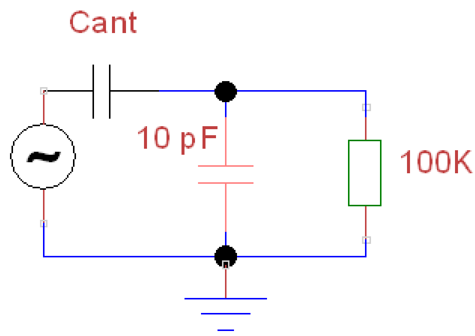

Fig.2 *A capacitive divider of the antenna voltage due to the input capacitance of the high Z amplifier. The corresponding antenna capacitances* C_{ant} *according to MMANA are: 12 pF, 18 pF and 24 pF.*

There is a voltage divider (***Fig.2***) which reduces the input voltage. The increase of the received signal when hats are used is due to higher effective height from one side and the increased equivalent capacitance of the antenna which reduces the voltage divider effects. If the input capacitance of the high Z amplifier is very low this effect will be not so high.

Summary

Even with very short capacitive hat of 0.3 m, a 4 dB increase in output voltage can be obtained.

Links

[1] *A Periodic Switching Technique to Compare Receiving Antenna Performance in the Presence of Strong Fading, http://www.lz1aq.signacor.com/docs/antenna-performance/switching-technique-compare-receiving-antenna-performance.htm*

[2] *https://active-antenna.eu/amplifier-kit/technical-documentation/*

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