MODELING AND ANALYSIS OF OMEGA ANTENNA FOR VHF BAND COMMUNICATION

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REZUMAT. Un rol important in domeniul comunicațiilor VHF il au repetoarele de semnal. Aceste dispozitive permit realizarea unor comunicații la distanțe mari caracterizate de un raport semnal/zgomot mare. În această lucrare mi-am propus să realizez o antenă verticală "omega"pentru banda de 2 m care să fie utilizată în componența unui repetor digital. Am testat performanțele acesteia, cunoscut fiind faptul ca o antena cu un castig ridicat are avantajul sensibilitații pentru semnalele provenite de la transceiverele portabile sau mobile de putere mica.

Cuvinte cheie:parametrii antenei, coeficient de unde staționare SWR, caracteristică de directivitate,digipeater.

ABSTRACT. An important role in VHF communications, it have signal repeaters. These devices allow for long distance communications, characterized by a high signal / noise. In this paper I wanted to achieve a vertical antenna "Omega" for the band of 2 m, which is used in the composition of a repeater. I tested its performance, knowing that a high gain antenna has the advantage of sensitivity to signals from mobile or portable transceiver for low power.

Keywords: antenna parameters, antenna gain, SWR, directivity characteristics, digipeater

1. INTRODUCTION

Generally, antennas can be built to have a uniform radiation in all directions (omnidirectional antennas), or present radiation dominance for a sense (omnidirectional antennas). In this article, I constructed and analyzed an antenna that is used in the structure of a digipeater.

Before proceeding to the realization of the antenna I preferred to simulate, using for this action program MMANA-GAL [1]. Measurement parameters in real conditions I used minivna analyzer [2], with which I highlighted in the VHF antenna behavior.

2. VHF antenna modeling

The antenna was designed for the frequency band 144-146 MHz, but the analysis parameters was performed for 432 MHz band, considering that currently transceiver provides facilities transceiver in several bands.

Construction details [3] are illustrated in Figure 1, the components are sized in millimeters.

This antenna is required to install an insulating material.

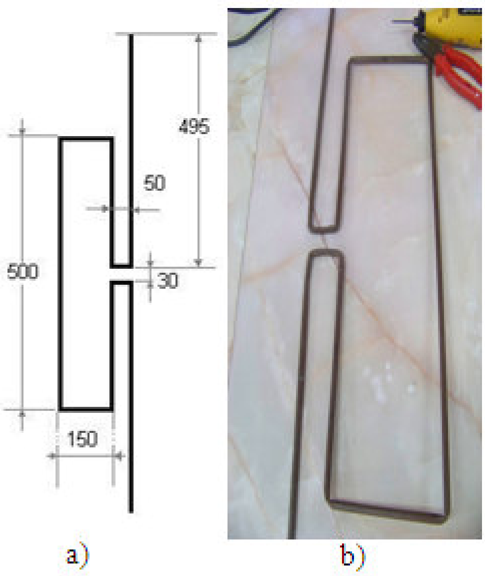


Fig. 1 a) Elements of the antenna
b) Antenna photography

The results obtained for the antenna version under review are shown in Table 1 and Table 2 and detailed in Figures 2÷7.

Table 1
Parameters antenna working frequencies in the range 144-147 MHz

No.	F (MHz)	R (Ohm)	jX (Ohm)	SWR 50	Gh dBd	Ga dBi	F/B dB	Elev.	Ground	Add H.	Polar.
7	144.8	18.74	-2.93	2.68	---	4.23	-0.32	73.2	Real	20.0	hori.
6	145.0	18.91	-0.2155	2.64	---	4.23	-0.33	73.0	Real	20.0	hori.
5	147.0	20.82	26.7	3.19	---	3.76	-0.06	84.0	Real	20.0	hori.
4	146.0	19.82	13.24	2.73	---	4.21	-0.41	72.0	Real	20.0	hori.
3	144.0	18.15	-13.52	2.98	---	4.19	-0.26	74.3	Real	20.0	hori.

Table 2
- Parameters antenna working frequencies in the range 430 ÷ 436 MHz

No.	F (MHz)	R (Ohm)	jX (Ohm)	SWR 50	Gh dBd	Ga dBi	F/B dB	Elev.	Ground	Add H.	Polar.
2	36.0	298.2	-111.4	6.82	---	6.25	-2.2	45.0	Real	20.0	vert.
2	434.0	314.2	-124.7	7.3	---	6.12	-1.07	48.0	Real	20.0	vert.
2	430.0	354.3	-142.8	8.26	---	6.07	-1.97	43.0	Real	20.0	vert.
2	428.0	375.6	-146.7	8.68	---	5.64	-1.34	49.0	Real	20.0	vert.
1	432.0	333.3	-135.7	7.79	---	5.93	-1.95	47.0	Real	20.0	vert.

In Figure 2, above, is presented the evolution chart reactance value, while the lower are the value of purely resistive impedance in frequency.

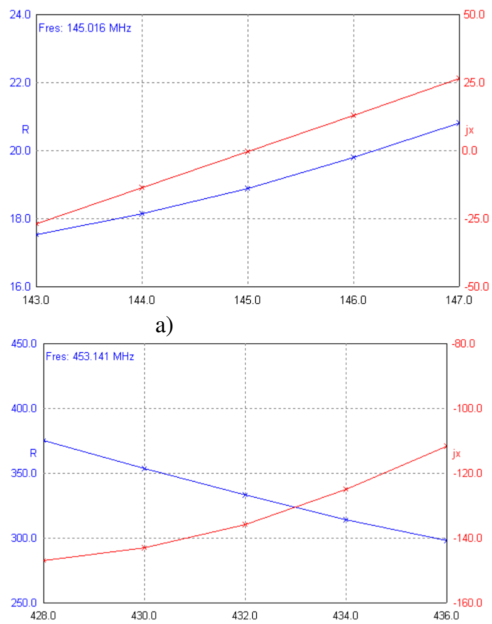


Fig. 2 Illustration subcomponents impedance Z [Z=R+jX]
a) 145 MHz b) 432 MHz

Figure 3 is illustrated the value of standing wave ratio SWR for frequencies around the central frequency of 145 MHz.

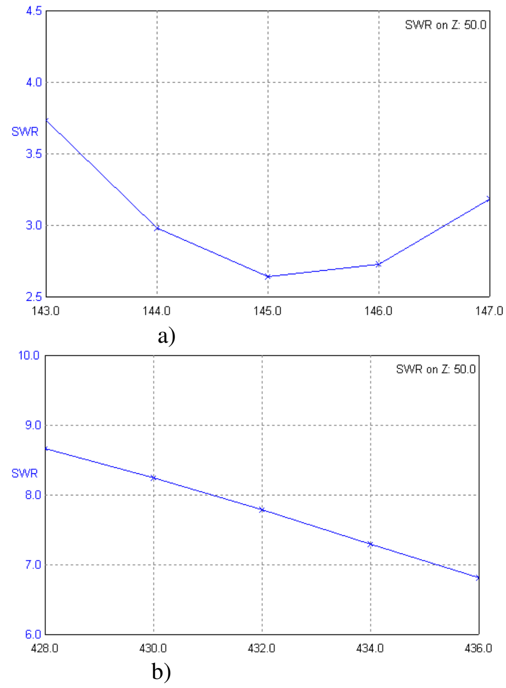
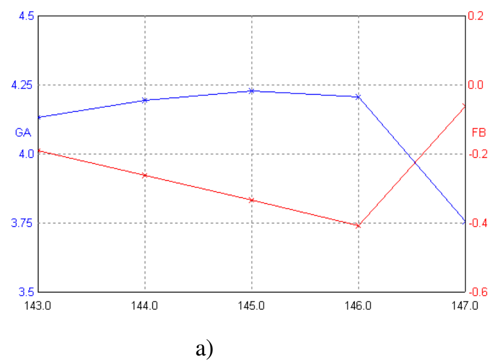


Fig. 3 Illustrate the coefficient values of standing waves SWR
a) 145 MHz b) 432 MHz

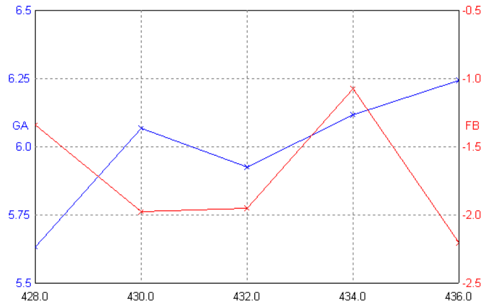
We note that SWR values are large (over 2). In this case, granting looking antenna, by lengthening or shortening of elements from the amounts calculated. If the feeder is coupled through capacitor, it acts upon it, until the ratio of standing waves, get under 1 :1,3.

Whether antennas are used for transmission or reception of such an important parameter is the gain. Some antennas are directive, meaning that a larger amount of energy is radiated in one direction than in others. The ratio between the amount of energy radiated on the main and radiated by a non-directive antenna (isotropic radiator), is called antenna gain.

In Figure 4, upper graph, is represented antenna gain (GA) and the bottom is shown the front / back ratio(FB).



a)



b)

Fig. 4 Illustration of antenna gain [GA] and the ratio front / rear [FB]
a) 145 Mhz b) 432 Mhz

The standard IEEE nr. 145/1983: *„absolute gain of an antenna in a given direction is equal to the ratio of radiation intensity in that direction and intensity of radiation that would be obtained if the antenna were radiated isotropically, all input power. Radiation intensity corresponding isotropic radiated power is, in turn, equal to the ratio between input power and 4π."*[4]

ϕ is the angle made with the z axis and θ is the angle to the x axis This coordinate system, called the spherical coordinate system; $P_{\Omega}(\phi,\theta)$ = intensity of radiation in the direction determined by θ and ϕ ; P_{in} = input power

If an antenna, which has a gain in emission, is used as an antenna for reception, it will have the same gain and reception.

Front / back ratio of antenna is important parameter, especially at the reception, because tells us how signals are attenuated (noise) behind the antenna. Basically, it was agreed that the report front / rear connection only 200km (short skips) is 10dB, the contribution is, the vertical angle of radiation.

Energy radiated from an antenna form an electromagnetic field that has a certain distribution in space. This distribution of energy radiated into space, called feature (diagram) of directivity, for the antenna considered and the frequency of 145 MHz is shown in Figure 5.

To represent the directivity characteristic, are used two types of graphs, one in polar coordinates, the other in rectangular coordinates. Polar coordinate graph has proved very useful in studying the directivity characteristics. Diagram is the circular, exactly as it appears in reality. Circles represent the energy radiated intensity levels.

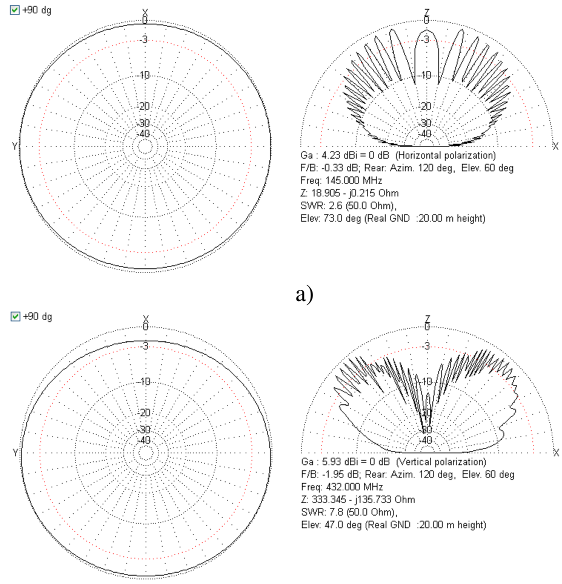
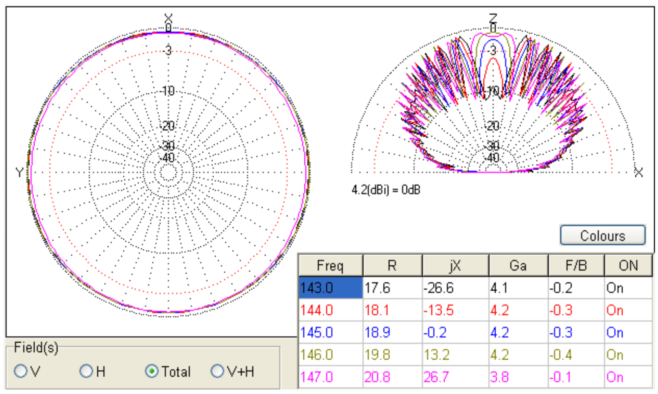
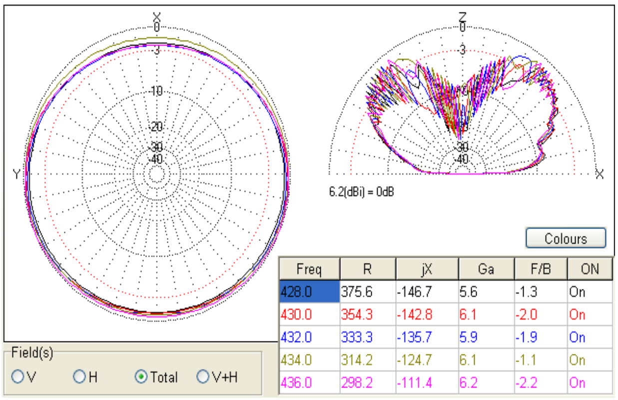


Fig. 5 Directivity characteristic for frequency of 145 MHz
a) 145 Mhz b) 432 Mhz

Directivity characteristic is actually a graphical representation of space, the energy radiated by an antenna. To determine the directivity characteristic, radiant energy is measured in points at the same distance, but in different directions from the antenna. Forms of directivity characteristics for the antenna used, but for frequencies near the frequency of 145 MHz can be seen in Figure 6.



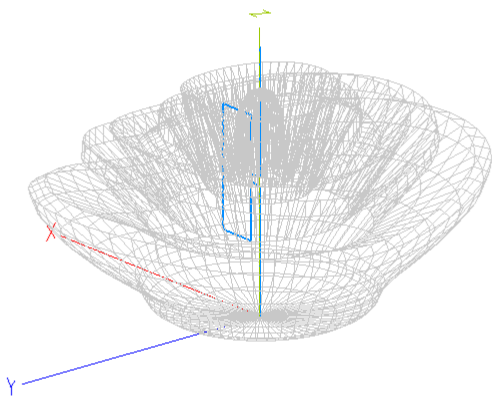
a)



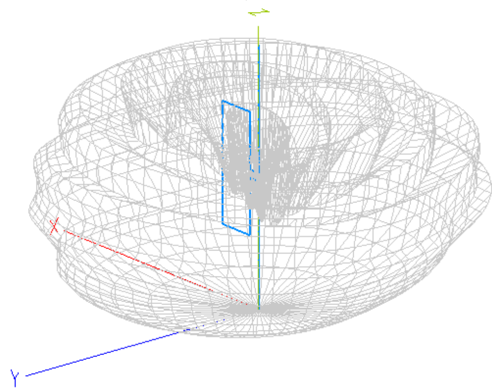
b)

Fig. 6 Energy radiated from the antenna, the neighborhood of 145 MHz frequency

a) 145 Mhz b) 432 Mhz



a)



b)

Fig.7 - 3D shape of the antenna radiation

a) for frequency 144 MHz;

b) for frequency 432 MHz

3. Model results

I made antenna from copper tube with a diameter of 5 cm, is fed with coaxial cable 50 or 75 Ω. Basically, when the cable is different from 75Ω impedance for adaptation cable (hot spots) are coupled by a variable capacitor, 60pF 10 ... which is seeking an optimal agreement.

Measurement of antenna analyzer was performed with minivna [3]. Antenna parameter values can be seen in the graphs in Figure 8, and the frequency limit values are given in Table 3.

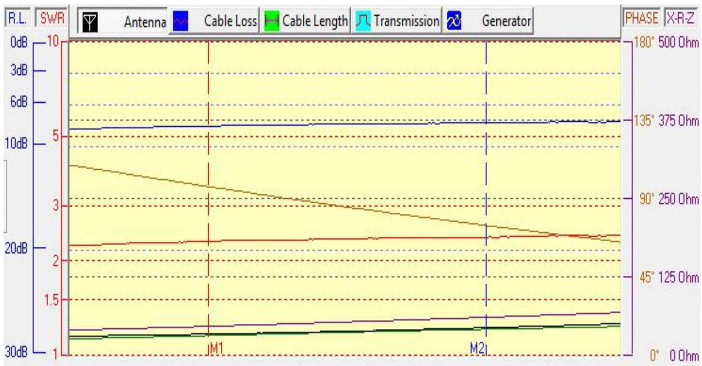


Figure 8 - Graph of evolution of antenna parameters obtained with the analyzer minivna

Table 3

Parameter values for the frequency limit of VHF field work, which was designed antenna

	FREQ.	SWR	|Z|	R.L.	PHASE	Rs	|Xs|
Marker 1	144,000,000	2.3	46.2	8.07	96.69	33.83	31.46
Marker 2	146,000,000	2.38	60.55	7.78	74.36	44.04	41.56

Shown in Table 3 that, there is no major differences between the values of antenna parameters to the values resulting from the simulation program MMANA-LAG (Table 1). SWR values are slightly lower for real, this is a good thing.

4. Conclusions

The antenna is, at present, used a digipeater configuration, together with a Katronix modem and a station Motorola GM 300, running for 144.800Mhz frequency with a power of 15 W. Support antenna is a telescopic aluminum with a height of 20m above the ground.

In this configuration, managed to open I gate two sites, one located in Piatra Neamt and Iasi each other.

Receiving stations, digital repeater within range, fixed (operators and weather stations) and mobile (trackers), with lower power but with omnidirectional antennas, can be easily monitored http://aprs.fi site by transferring information with the digipeater.

I tried that plan antenna when it is mounted on the pillar, to be as horizontal. After construction of the antenna coupling to a transmitter will be interposing a meter of standing waves. For this operation, I set the antenna height of 20 m from the ground, and I was careful, not to be nearby objects or obstacles.

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After finishing university I worked in high school education. Research topics have been directed toward designing telecommunications equipment VHF and UHF band.