Broadband Indoor Antenna

Igor Grigorov, VA3ZNW

E-mail: antentop@antentop.org

It was in winter 1994. In that time heavy winter winds destroyed my outdoor antennas. I could not do repairs of the antennas at cold winds and snowdrifts so I decided to try indoor antennas. I tried several antennas at the times. The article describes one of them, a very simple antenna that can work at all amateurs bands.

Figure 1 shows the design of this antenna. It is a loop of a wire that installed at the perimeter of a window with sizes 210 x 140 centimeters. The loop is loaded to 600 Ohms from one side another side of the loop is connected to a transformer 9:1.

So this transformer provides matching 600 Ohms to 75 Ohms. At the time I used a home made transceiver plus a home made broadband transistors PA that worked well to load of 75 Ohm. The antenna worked from 160 through 10 meters, however, at 160 and 80 meters the antenna worked not satisfactorily. But at 40 and at the others higher bands the antenna did not bad job.

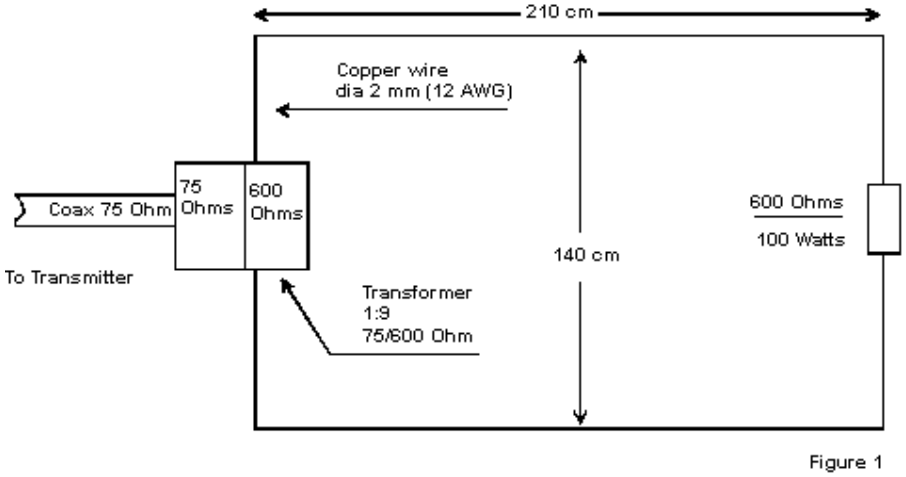


Figure 1 Broadband indoor antenna

For the antenna I used a home made RF transformer. **Figure 2** shows the schematic and design of the transformer. Winding of the transformer was made by a twisted wire, 2 twist per 1 centimeter, each wire was 0.7-mm in diameter (21 AWG), each wire was covered by Teflon. For form of the transformer I used a ferrite core from a yoke of a color 27" TV.

The numbers of turns of the transformer depend on the sizes of the yoke core and on to working frequencies. I could not manage to make a transformer that would provide job of the antenna at 160 through 10 meters. Three different transformers were used to cover the range of 160-10 meters.

I switched needed me transformer when I changed a band. At my case, for 160- 80 meters the transformer contained 18 turns, for 40- 20 meters the transformer contained 12 turns, for 15- 10 meters the transformer contained 8 turns. The turns were evenly distributed on the ferrite ring. The transformers were placed in a box made of PC- board stuff. The box was located near antenna terminal. **See photo.**

Figure 3 shows the circuit for testing of a working range of the RF transformer. Output of the transformer is connected to 600 Ohm load, input to a RF- Bridge. When working range of the transformer is determinate, you can change the range in needed side. It is possible to lower frequency range of the transformer by increasing number of its turns.

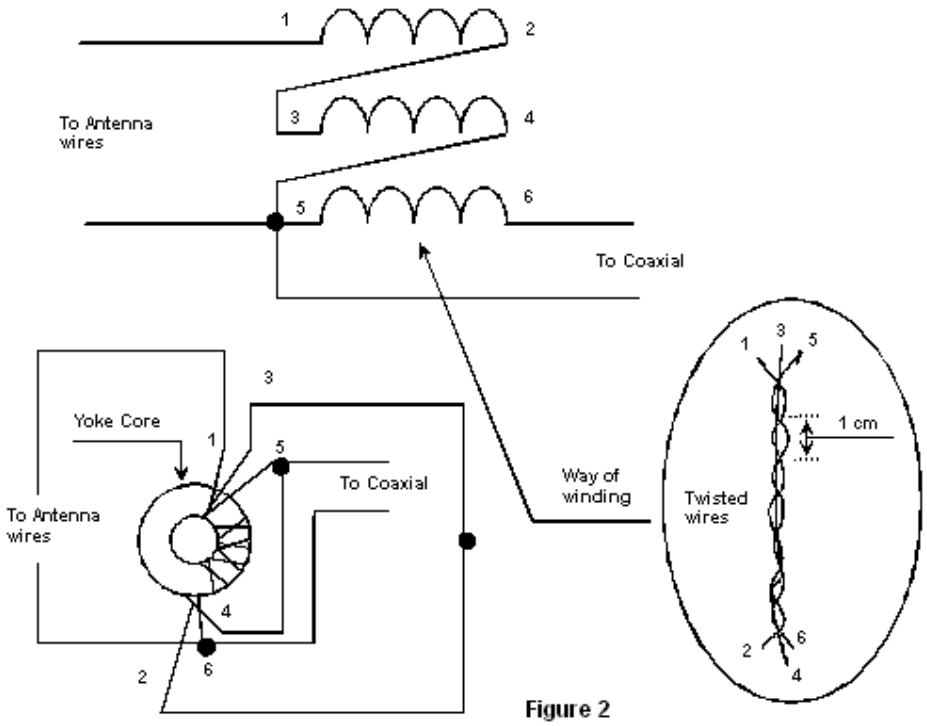
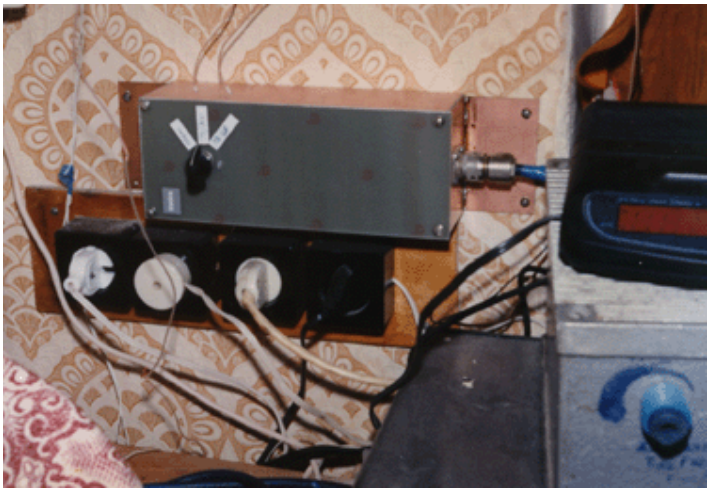


Figure 2

Figure 2 Transformer 9:1

It is possible to increase frequency range of the transformer by decreasing number of its turns. After adjustment of the transformer at active load 600 Ohm connect the transformer to real antenna and do fine tuning by increasing/decreasing turns on 1-2 turns.



Box with RF transformers installed near a window

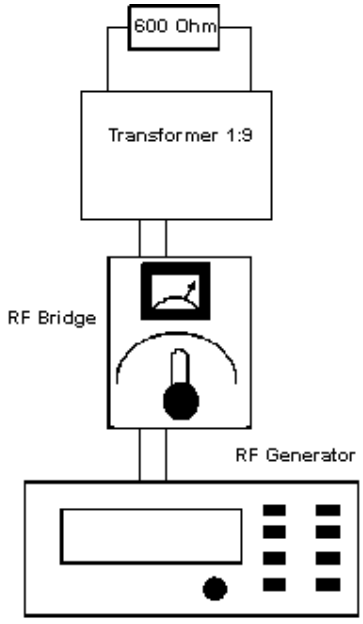


Figure 3

Figure 3 Circuit for testing of a working range of the RF transformer

Broadband Indoor Antenna

At that times I had a broadband transformer 9:1 from an old marine transmitter, the transformer worked good at 160- through 10 meters, but, unfortunately, the transformer had small sizes and it was very hot already at 50 Watts. Transformers made on a yoke ferrite core from 27" TV worked good at 200 Watts…

I experimented with antenna loads of 450 and 300 Ohms however, antenna with these loads was hard to match.

Recently using MMANA (**References 1**) I simulated parameters of the antenna loaded to 600, 450, 300 Ohms. For simplification it was supposed that the antenna is located in a free space. **Table 1** shows the data.

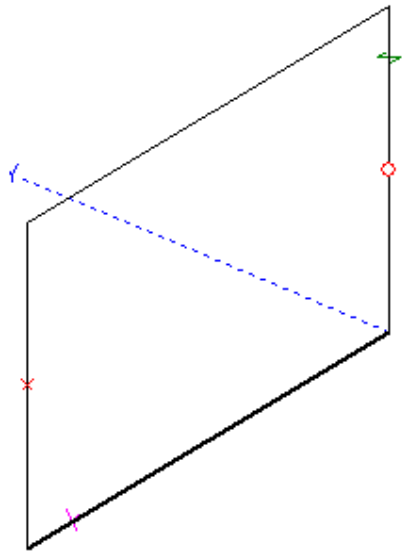
Table 1 Data for broadband antenna

Band, meters	Gain, dB			SWR		
	600 Ohm	450 Ohm	300 Ohm	600 Ohm	450 Ohm	300 Ohm
160	-56	-56	-56	1.05:1	1.1:1	1.1:1
80	- 44	- 44	- 44	1.07:1	1.2:1	1.5:1
40	- 30	- 30	- 30	1.2:1	1.6:1	2.6:1
20	- 19	- 19	- 19	1.4:1	2.25:1	4.6:1
15	- 13	- 13	- 13	1.55:1	2.7:1	6.1:1
10	- 10	- 10	- 10	1.62:1	2.6:1	5.2:1

The table shows that the antenna has best SWR at 160 through 10 meters only at the 600 Ohm load. I can notice, that in real conditions, the antenna has SWR better then shown by the **Table 1** because losses RF energy in the nearest subjects.

The table shows that the antenna is 'dead' at ranges 160 and 80 meters, but at good propagation you could make QSOs. Antenna gain is small at 40 through 10 meters too, but already even at rather average propagation (and 100 Watts in the antenna) I could easy make QSOs using the antenna.

MMANA shows that the antenna has one sided directivity, but I could not see that when I have used the antenna. See screenshots of the antenna simulated by the MMANA.

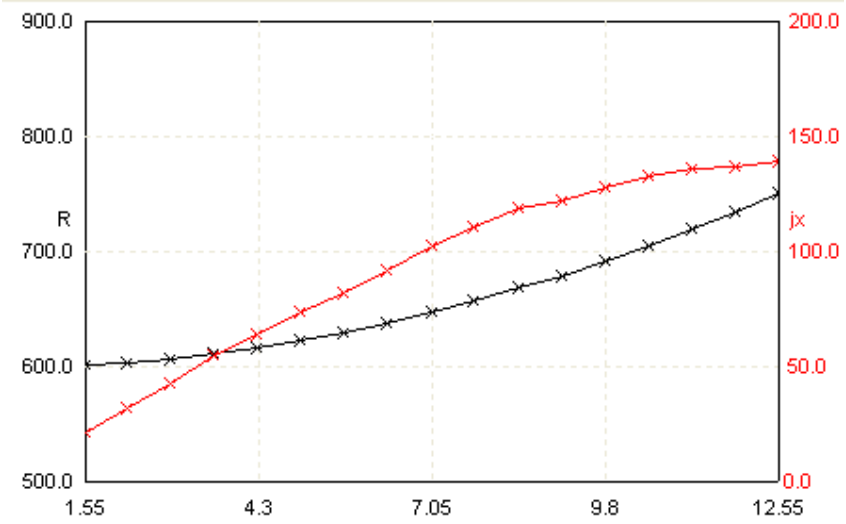


Broadband Antenna in MMANA

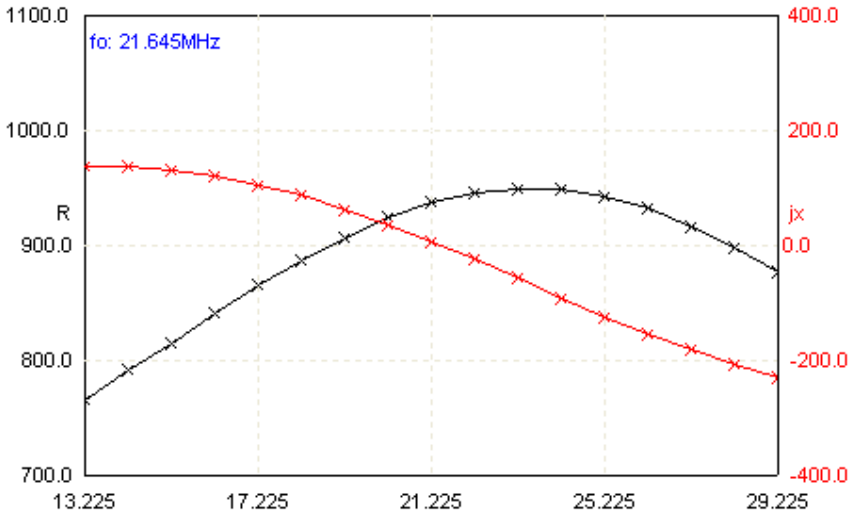
References

1. http://mmhamsoft.ham-radio.ch/

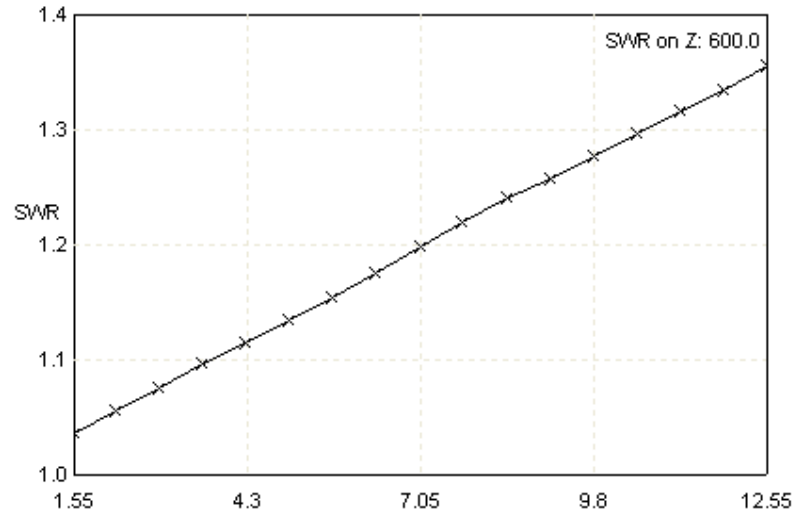
73! I.G.



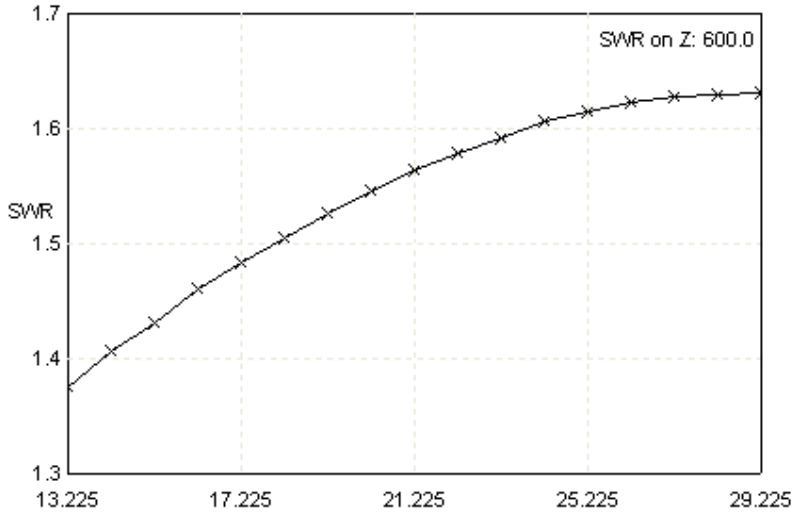
Broadband Antenna. Z at 600 Ohm, 1.55- 12.55 MHz



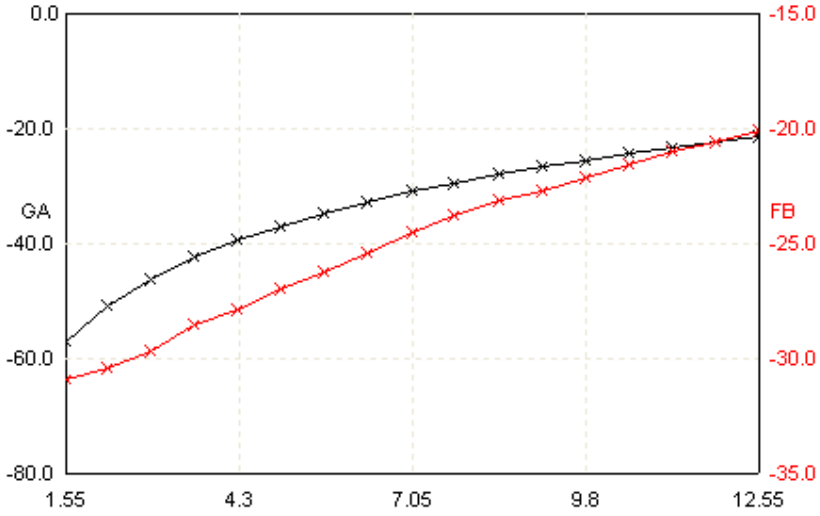
Broadband Antenna. Z at 600 Ohm, 13.25- 29.25 MHz



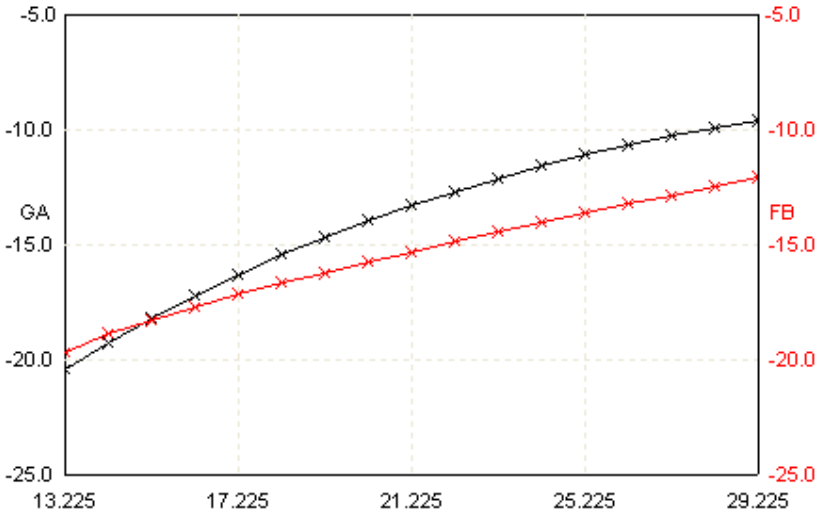
Broadband Antenna. SWR at 600 Ohm, 1.55- 12.55 MHz



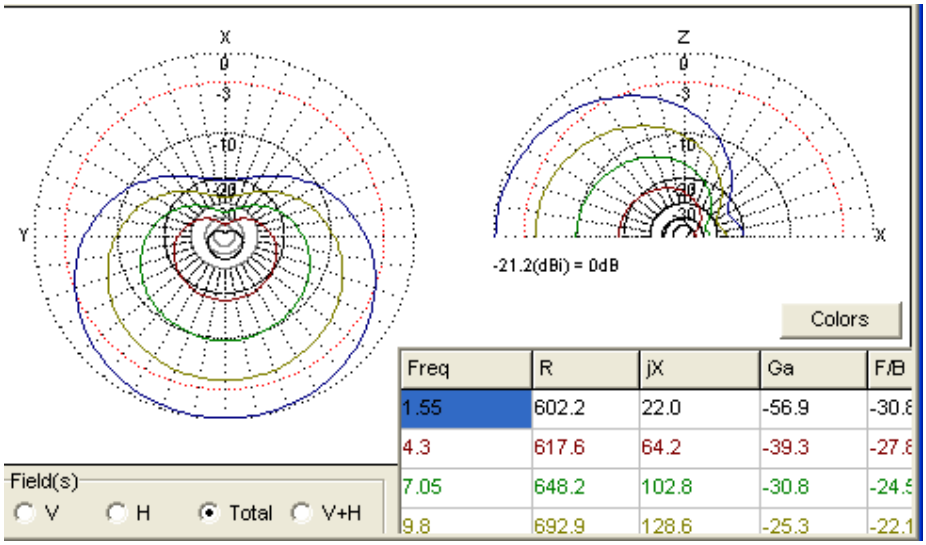
Broadband Antenna. SWR at 600 Ohm, 13.25- 29.25 MHz



Broadband Antenna. Gain at 600 Ohm, 1.55- 12.55 MHz

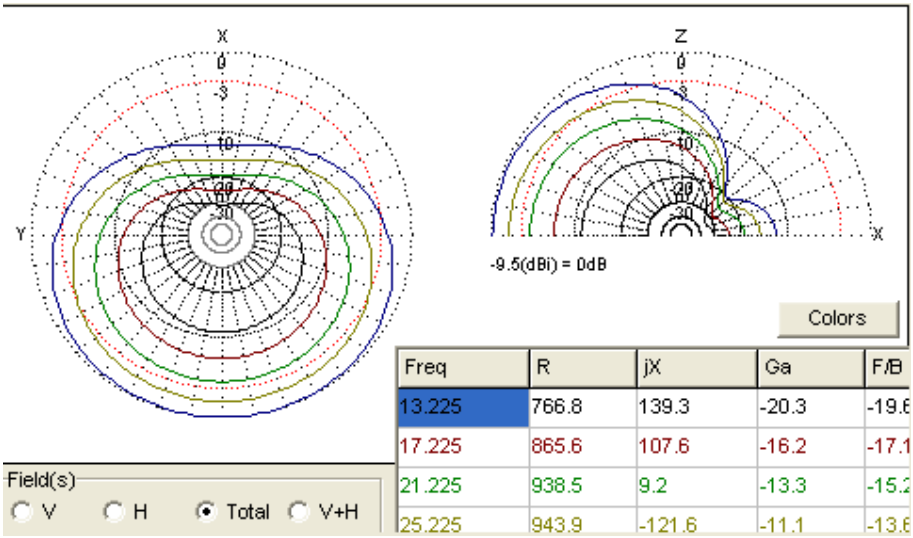


Broadband Antenna. Gain at 600 Ohm, 13.25- 29.25 MHz



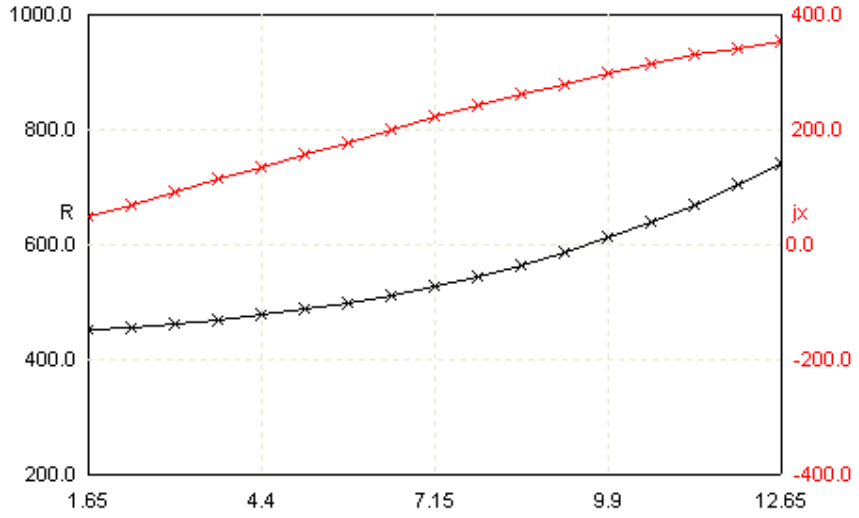
Freq	R	jX	Ga	F/B
1.55	602.2	22.0	-56.9	-30.8
4.3	617.6	64.2	-39.3	-27.8
7.05	648.2	102.8	-30.8	-24.5
9.8	692.9	128.6	-25.3	-22.1

Broadband Antenna. Plot at 600 Ohm, 1.55- 12.55 MHz

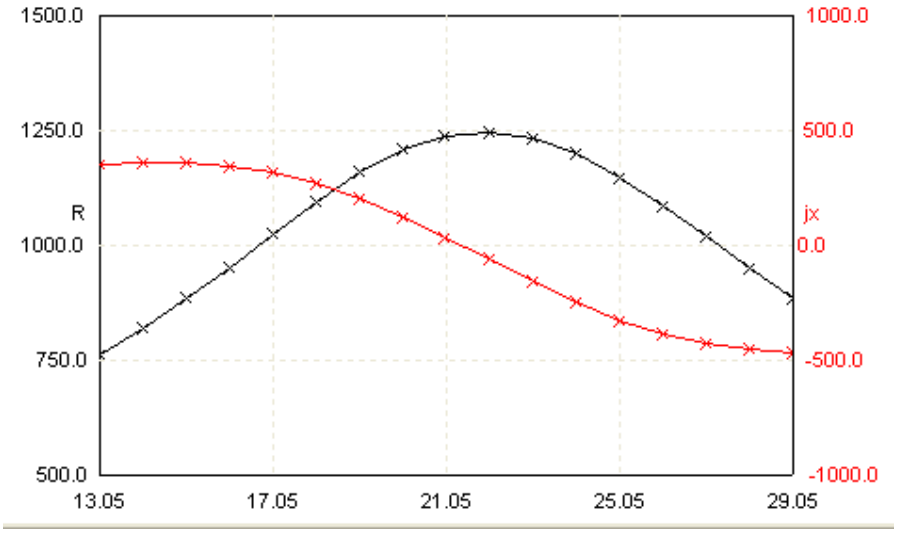


Freq	R	jX	Ga	F/B
13.225	766.8	139.3	-20.3	-19.6
17.225	865.6	107.6	-16.2	-17.1
21.225	938.5	9.2	-13.3	-15.2
25.225	943.9	-121.6	-11.1	-13.6

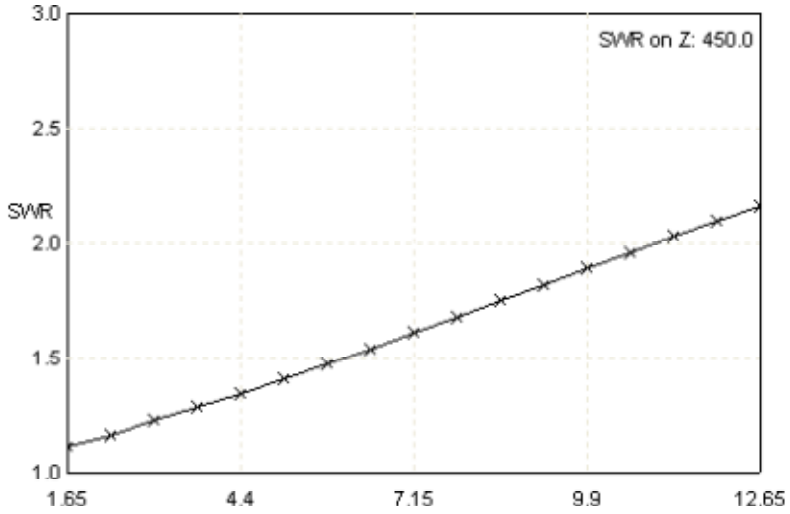
Broadband Antenna. Plot at 600 Ohm, 13.25- 29.25 MHz



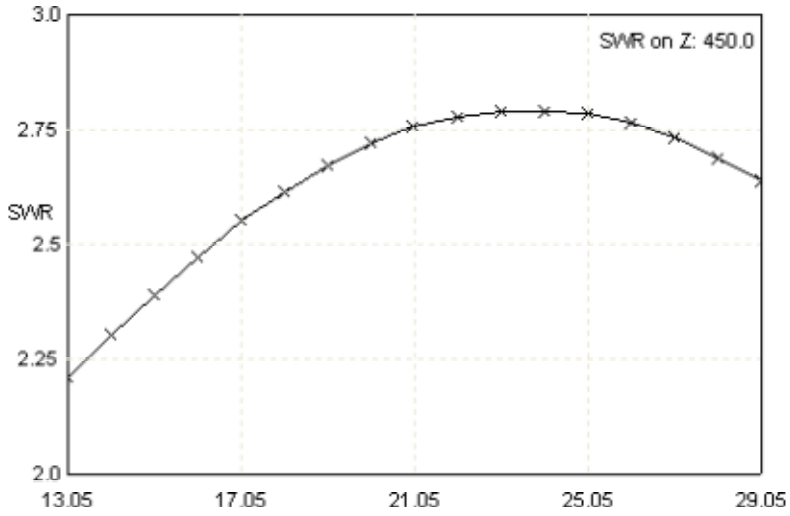
Broadband Antenna. Z at 450 Ohm, 1.65- 12.65 MHz



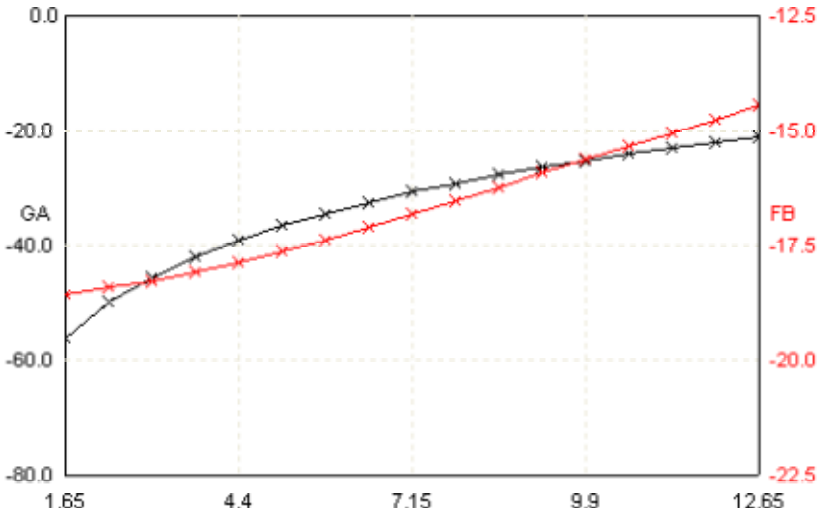
Broadband Antenna. Z at 450 Ohm, 13.05- 29.05 MHz



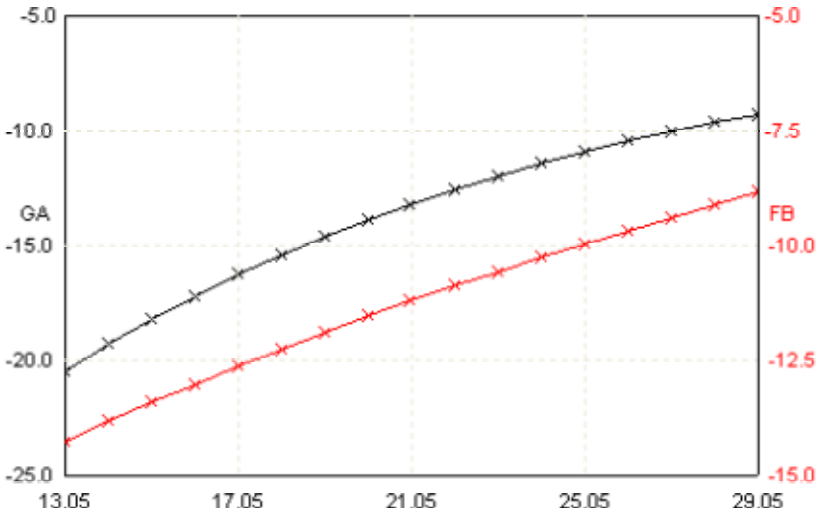
Broadband Antenna. SWR at 450 Ohm, 1.65- 12.65 MHz



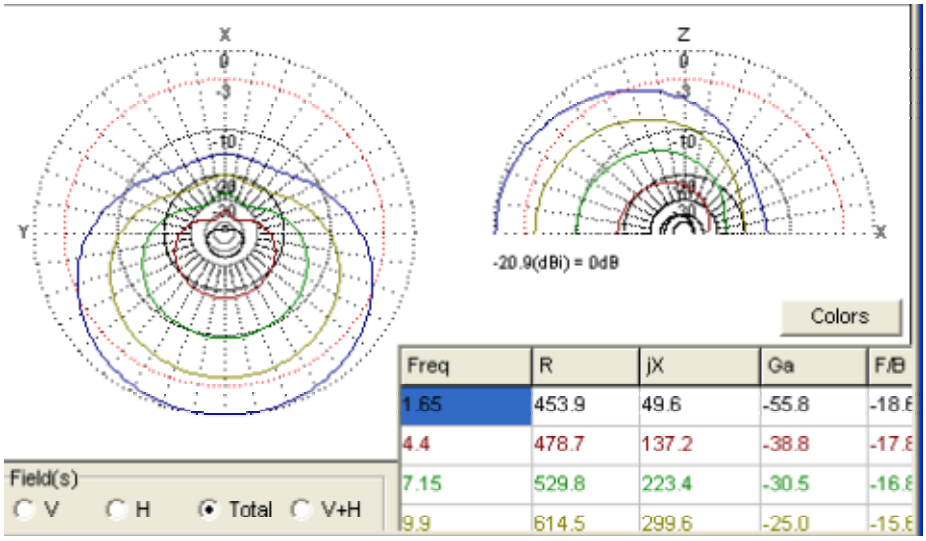
Broadband Antenna. SWR at 450 Ohm, 13.05- 29.05 MHz



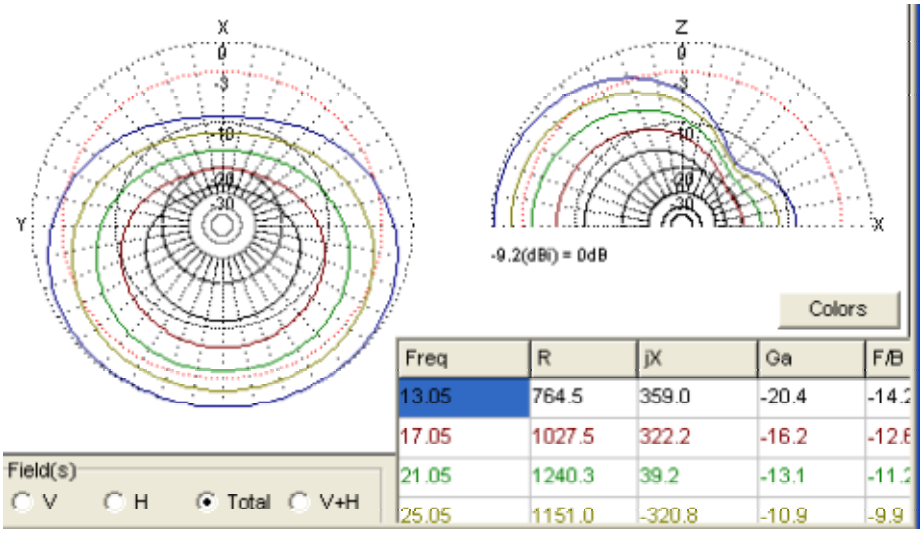
Broadband Antenna. Gain at 450 Ohm, 1.65- 12.65 MHz



Broadband Antenna. Gain at 450 Ohm, 13.05- 29.05 MHz

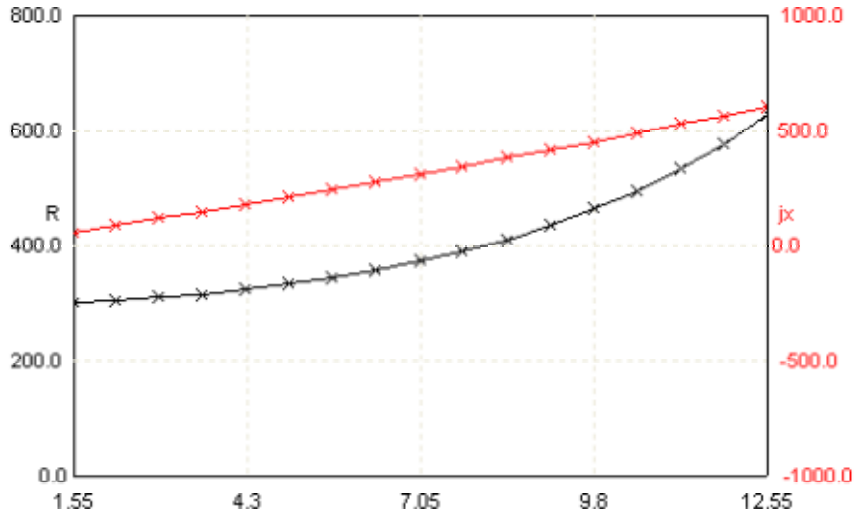


Broadband Antenna. Plot at 450 Ohm, 1.65- 12.65 MHz

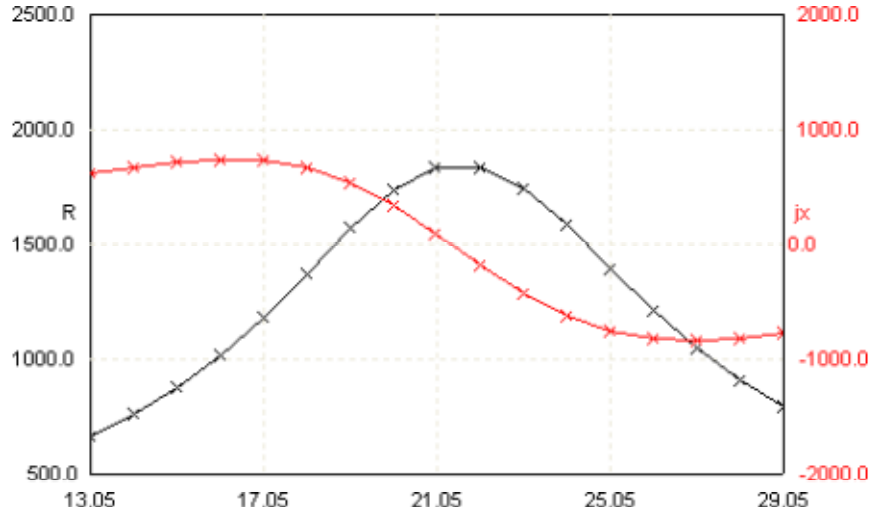


Freq	R	jX	Ga	F/B
13.05	764.5	359.0	-20.4	-14.2
17.05	1027.5	322.2	-16.2	-12.8
21.05	1240.3	39.2	-13.1	-11.2
25.05	1151.0	-320.8	-10.9	-9.9

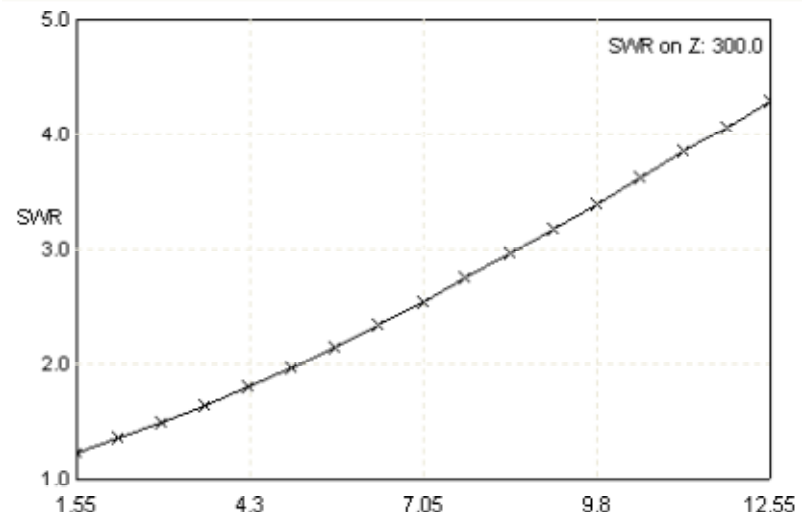
Broadband Antenna. Plot at 450 Ohm, 13.05- 29.05 MHz



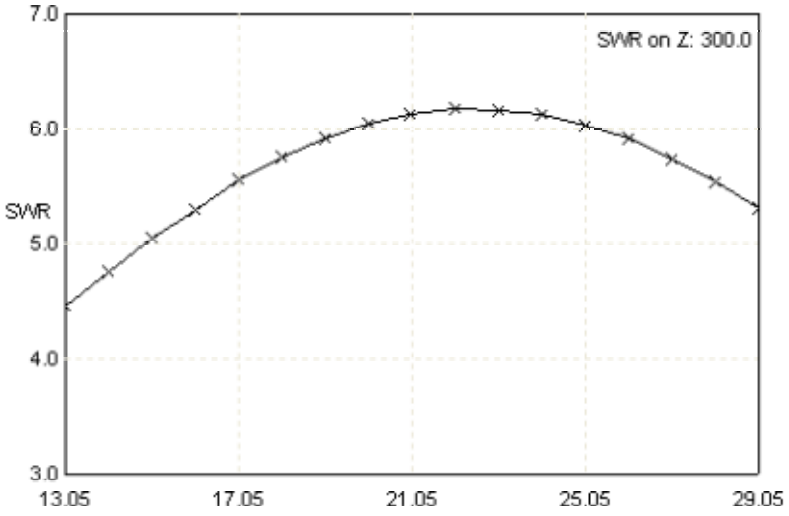
Broadband Antenna. Z at 300 Ohm, 1.55- 12.55 MHz



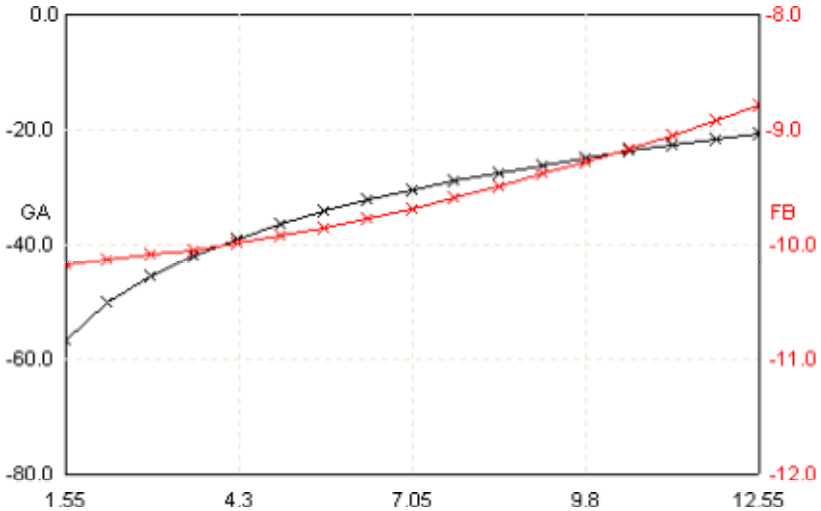
Broadband Antenna. Z at 300 Ohm, 13.05- 29.05 MHz



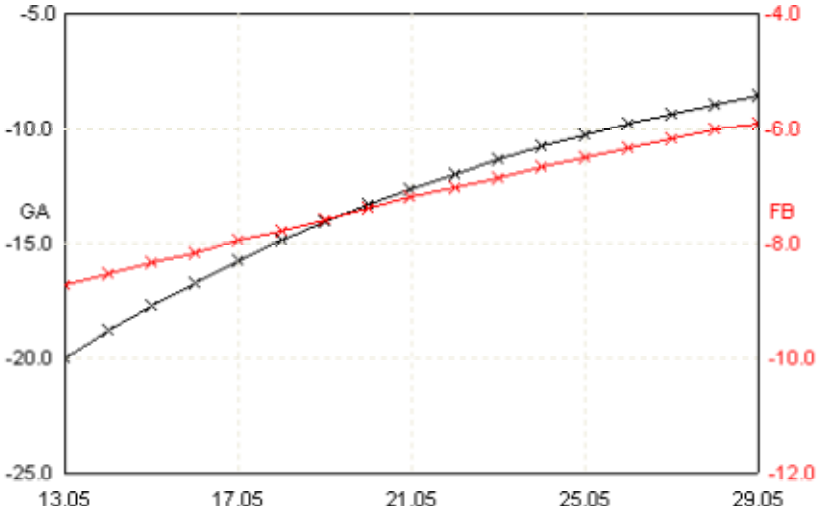
Broadband Antenna. SWR at 300 Ohm, 1.55- 12.55 MHz



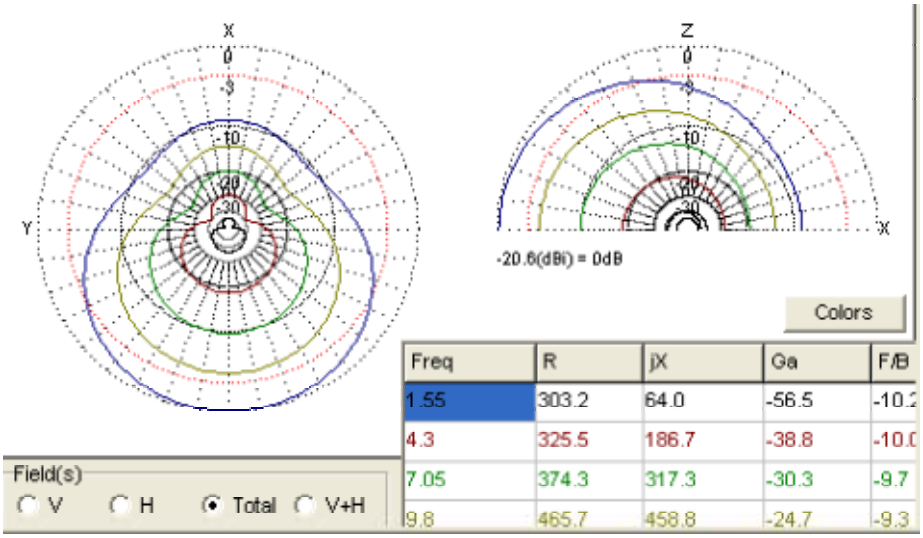
Broadband Antenna. SWR at 300 Ohm, 13.05- 29.05 MHz



Broadband Antenna. Gain at 300 Ohm, 1.55- 12.55 MHz

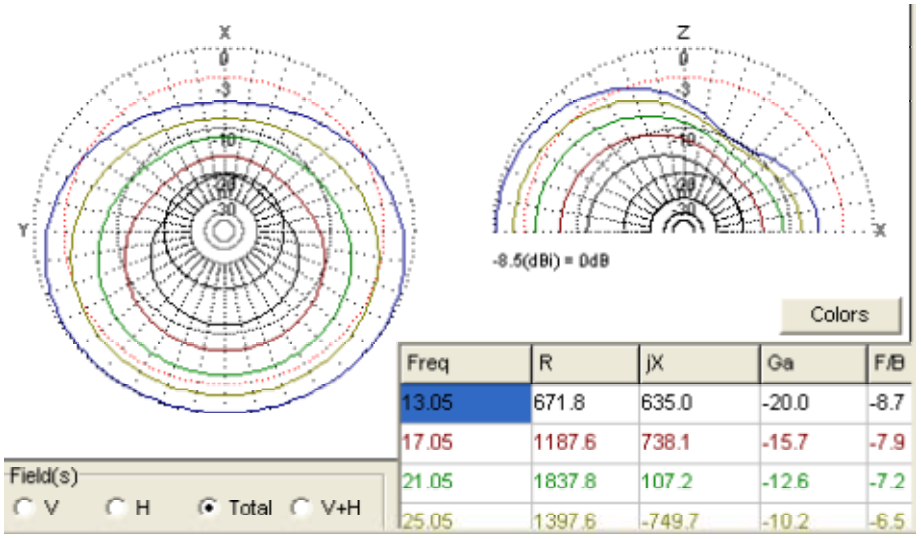


Broadband Antenna. Gain at 300 Ohm, 13.05- 29.05 MHz



Freq	R	jX	Ga	F/B
1.55	303.2	64.0	-56.5	-10.2
4.3	325.5	186.7	-38.8	-10.0
7.05	374.3	317.3	-30.3	-9.7
9.8	465.7	458.8	-24.7	-9.3

Broadband Antenna. Plot at 300 Ohm, 1.55- 12.55 MHz



Freq	R	jX	Ga	F/B
13.05	671.8	635.0	-20.0	-8.7
17.05	1187.6	738.1	-15.7	-7.9
21.05	1837.8	107.2	-12.6	-7.2
25.05	1397.6	-749.7	-10.2	-6.5

Broadband Antenna. Plot at 300 Ohm, 13.05- 29.05 MHz