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MODELLING OF ANTENNA OPEN HALF LAMDA USING AUTOMATIC ANTENNA PLOTTER DETECTOR TESTING AT UHF BROADCAST FREQUENCY

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Abstract

Dipole antennas are quite popular in various research in the field of antenna technology. Many models and modifications have been made to obtain optimal performance according to the application field. Of the many models of this antenna, it turns out that not many of this type of antenna has the same function as a transmitting and receiving antenna. Therefore, the aim to be achieved in this research is to model a half-wavelength open UHF dipole antenna to work well on UHF broadcast frequency allocation. The method to realize this is using a comparative test approach, which begins with designing a physical model of the antenna, then it is tested by an antenna plotter detector automatically, the result is a visualization of the shape of the antenna radiation pattern. From this radiation pattern, the gain angle area, transmit power, receiving power, and Return Loss will be seen. Based on the test results, the maximum transmit power of each antenna is 121 mWatt and the received power is 97 mWatt with a return loss value of -18.78 dB at the broadcast UHF frequency of 428.5 MHz.

Keywords: Automatic antenna, Broadcast, Modelling Testing, UHF.

1. Introduction

The development of antenna technology for various communications is currently very developed and has resulted in many innovations in antenna models for long-distance and long-distance communication purposes using air or wireless transmission media. The majority of wireless media are mostly applied to long-distance transmission communications with various variations in their working frequency allocations. Of course, transmitting information over long distances by air requires devices that can send and receive information with good quality [1, 2]. An antenna is one of the devices that have the ability as a long-distance connecting device through the air transmission medium [3]. The problem is that not all antennas themselves can perform two tasks at once, namely as a transmitter and a receiver. Not many studies have designed and modelled an antenna that functions as a transmitter and receiver of radio waves simultaneously (transceiver). Many models of transceiver antennas have been designed but taking into account several factors such as ease to design, inexpensive and the basic materials are easy to obtain and produce a good performance. Based on these criteria, it seems that the dipole antenna model can be used as a reference for realizing the transceiver antenna. The dipole antenna itself is a radio antenna that has two conductor rods, parallel and collinear oriented which place the supply in the middle to receive and transmit waves [1].

The design of the dipole antenna model has been carried out by several previous researchers. In the results of research [4], a dipole antenna is only used as a digital TV receiver that works at a frequency allocation of 600 MHz which produces a VSWR value of 1.55 and a return loss of -22.9 dB. The greater the value of VSWR approaching the value of 2, the performance will decrease the transmit power and reception of the antenna. Another study [5, 6] produced a half-wavelength dipole antenna model as a learning support medium through the design and testing of simulations that only functioned as a UHF television receiving antenna which has not been tested as a transceiver antenna.

From the results of the comparison of several previous studies, it shows that there is an unexplored space where the majority of dipole antenna models so far only discuss one use, namely as a transmitting or receiving antenna. Therefore, the purpose of this research is to create a dipole antenna model that can simultaneously transmit and receive UHF frequency waves using a comparative method as the basis for realizing this antenna model.

2. Research Method

In designing and realizing this antenna, the method approach used is a comparative method which begins with calculating the antenna parameters before the design is carried out, then testing using simulation and measurements to obtain the conformity of the results. The design stages are shown in Fig. 1.

This method requires quite a lot of data related to the specifications of the designed antenna [7]. This is useful so that the achievement target is to produce an antenna model that has the same performance both when working as a transmitter and receiver simultaneously. The specifics of the antenna to be designed are stated as follows:

- Frequency Operation : 428.50 - 470 MHz
- VSWR : 1.5

- Gain : 2.11 dB
- Impedance Feeder : 50 Ω
- Base material : aluminum
- Radiation pattern : Omnidirectional

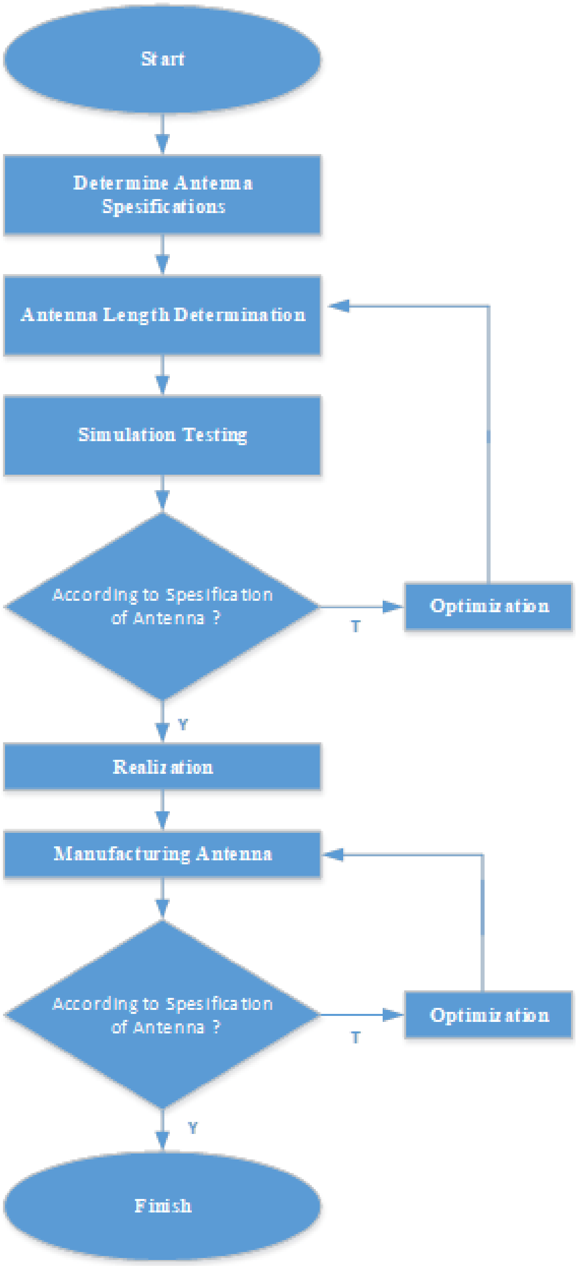

Fig. 1. The flow design of antenna dipole open $\frac{1}{2}\lambda$ model.

The design of this dipole antenna consists of two rods that function as a radiator as well as a reflector when modeling it is necessary to analyse how to determine the length of the two antenna rods so that the calculations are more precise. The design stage starts by determining the antenna parameters through calculation, simulation, and system testing. The calculation phase begins with determining the antenna wavelength using Eq. (1) [8, 9].

$$\lambda = \frac{c}{f} \tag{1}$$

From here, the length of the antenna rod can be measured according to Eq. (2) [9, 10].

$$L = \frac{1}{2}\lambda K \tag{2}$$

where L indicates the length of the antenna rod and K indicates the wave velocity factor in free space. Furthermore, the antenna gap width G is determined using Eq. (3) [10].

$$G = \frac{L}{200} \tag{3}$$

3. Results and Discussion

There will be two performance will be discussed, they are the achievement of the target and the human interfere in line purchase in the design and fabrication of the antenna based on the results of the comparative analysis between calculations, simulations, and measurements, the simulation results can be described with the results shown in Figs. 2 and 3.

Antenna field testing is carried out using an antenna plotter detector to obtain the actual antenna output voltage and power values from the design and simulation results. Furthermore, some of the results of these voltage and power values are used as input data to visualize the shape of this antenna radiation pattern.

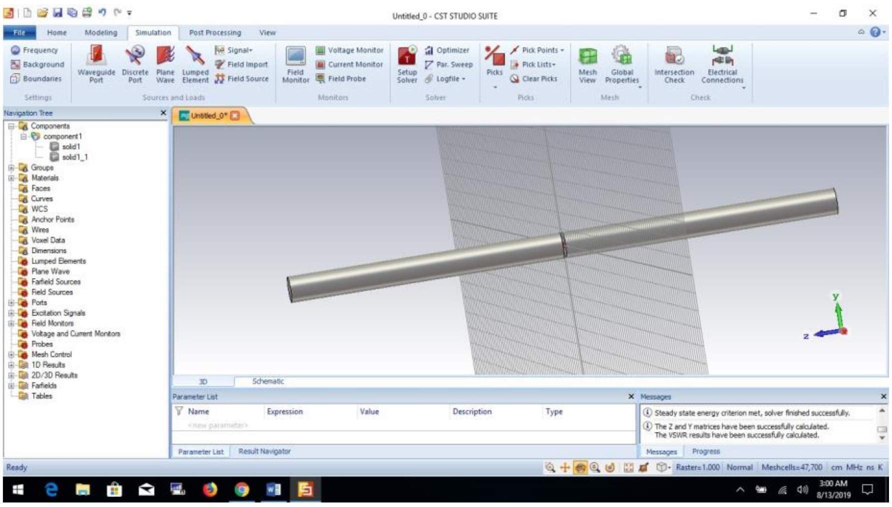

Fig. 2. Model of antenna dipole open1/2 UHF broadcast.
(a) Simulation results.

Fig. 3. Model of antenna dipole open1/2 UHF broadcast.
(b) Manufacturing results.

3.1. Simulation test results

Testing through this simulation approach aims to obtain reference values to measure the accuracy of the antenna calculation results. The parameters that are simulated include return loss, gain, and radiation pattern, the results of which can be seen in Figs. 4-6.

The return loss simulation results show the value obtained is -18.78 dB in the UHF Broadcast frequency range of 428.5 MHz with a fairly even gain angle. Therefore, by the basic nature of the dipole antenna which has an omnidirectional radiation pattern [9, 11].

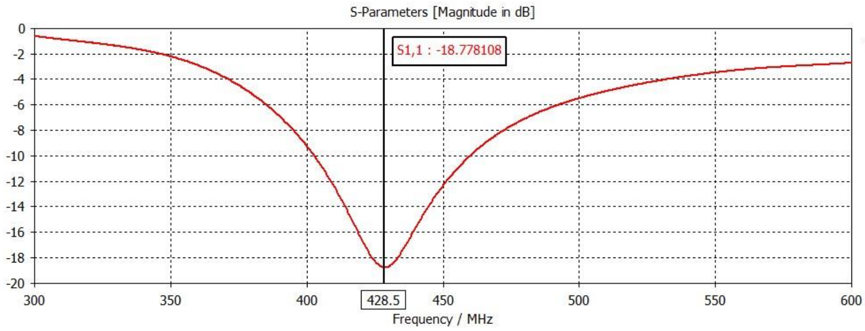

Fig 4. Simulation results of $\frac{1}{2}\lambda$ open dipole antenna; (a). Return Loss.

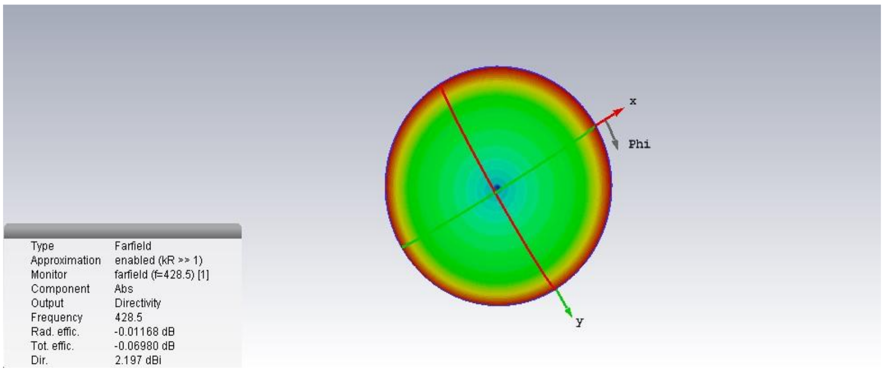

Fig. 5. Simulation results of $\frac{1}{2}\lambda$ open dipole antenna; (b). Reinforcement.

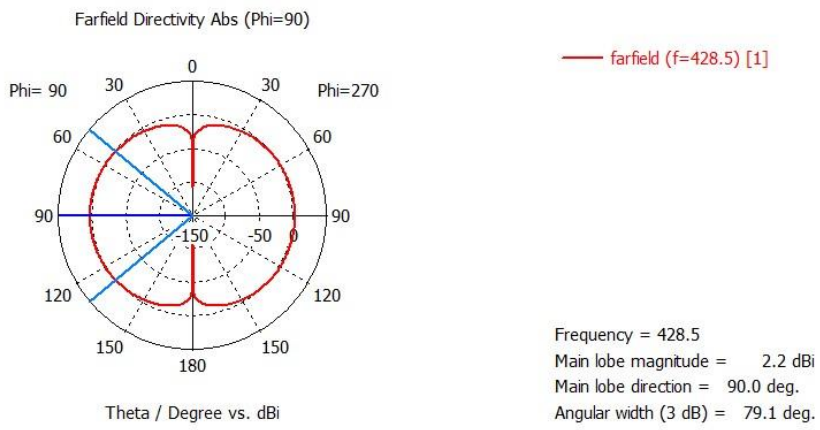

Fig. 6. Simulation results of $\frac{1}{2}\lambda$ open dipole antenna; (c). Radiation pattern.

3.2. Test results with antenna plotter detector

This test is carried out when the antenna has been prefabricated. The aim is to obtain field results related to the maximum power gain value when tested as a transmitting and receiving antenna [12]. This is done to determine the level of feasibility when the antenna is implemented in real environmental conditions. The measurement stage begins with measuring the voltage value through the help of a detector plotter antenna, the results of which will be used to find the maximum output power. The results can be illustrated in Tables 1 and 2 for each measurement of the antenna in the transmitter and receiver conditions.

Table 1. Measurement of Antenna Open $\frac{1}{2}\lambda$ (as transmitter).

Antenna angle position (Degrees)	Output voltage (Volt)	Output power (mWatt)
0^0	0	0
9^0	1.13	25
18^0	0.82	13
27^0	0.52	5
36^0	0.24	1
45^0	0.12	0,2
54^0	0.29	1
63^0	0.47	4
72^0	0.79	12
81^0	1.06	22
90^0	1.41	39
99^0	1.77	62
108^0	2.01	80
117^0	2.37	112
126^0	2.46	121
135^0	2.43	118
144^0	2.39	114
153^0	2.36	111
162^0	2.35	110
171^0	2.33	108
207^0	1.92	73

216^0	1.45	42
225^0	0.1	0,2
234^0	0.88	15
243^0	0.66	0,8
306^0	0.79	12
315^0	1.00	20
324^0	1.04	21
333^0	1.01	20
342^0	0.96	18

The occurrence of changes in antenna gains because it is linearly related to changes in the environment where the system is being tested is mainly influenced by dynamic changes in electromagnetic waves in free space [1, 9]. This can be analysed according to Table 1 which shows that there is no consistency in the results of antenna gain which can be seen from testing the angle position of the test antenna. The results of the data from Table 1 when the position of the dipole antenna as a transmitter is obtained a radiation pattern as shown in Fig. 7.

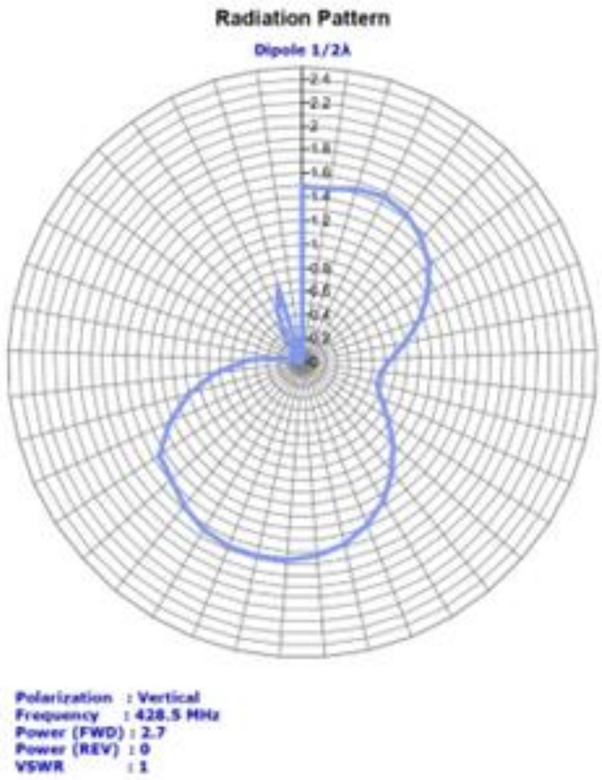

Fig. 7. Pattern radiation measurement of antenna open $\frac{1}{2}\lambda$ (as transmitter).

As for the results of testing the $\frac{1}{2}\lambda$ open dipole antenna where the antenna as a receiver can be seen in Table 2.

Table 2. Measurement of antenna open $\frac{1}{2}\lambda$ (as receiver).

Antenna angle position (Degrees)	Output voltage (Volt)	Output power (mWatt)
0^0	0.42	3
9^0	0	0
18^0	0	0
27^0	0.16	0.4
36^0	0.34	2
45^0	0.58	6
54^0	0.87	15
63^0	1.13	25
72^0	1.38	38
81^0	1.60	51
90^0	1.83	66
99^0	1.94	75
108^0	2.10	88
117^0	2.21	97
126^0	2.21	97
135^0	2.14	91
144^0	2.18	95
153^0	2.01	80
162^0	1.78	63
171^0	0.93	17
207^0	0.28	1
216^0	0.09	0.1
225^0	0.12	0.3
234^0	0.08	0.1
243^0	0.48	4
306^0	1.38	38
315^0	1.34	35
324^0	1.05	22
333^0	1.14	25
342^0	0.95	18

Gain changes also occur when the antenna is tested in the receiver position. Based on the measurement data according to Table 2, the antenna radiation pattern can be described as shown in Fig. 8.

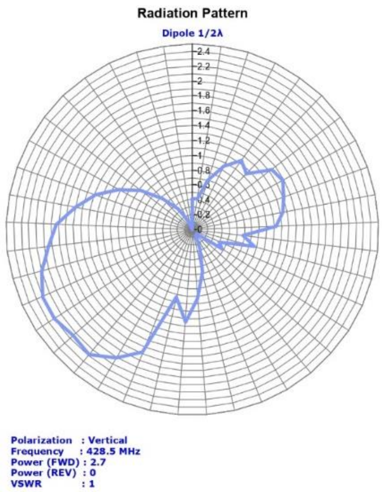

Fig. 8. Pattern radiation measurement of antenna open $\frac{1}{2}\lambda$ (as receiver).

4. Conclusion

From several test results, several conclusions can be drawn, including that the dipole antenna designed can work well at UHF frequency allocation by producing a return loss value of -18.78 dB and producing an increase in gain when tested as a transmitting and receiving antenna. Then based on the test results using an antenna detector plotter, it shows that the shape of the radiation pattern and the resulting antenna gain has dynamic variations. This is possible because of the dynamic changes of electromagnetic waves when the test is carried out in an open space.

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