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Fabrication and Implementation of a Microstrip Antenna for Digital Television Reception at UHF Frequencies

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Abstract— **Television broadcasting has evolved from analog to digital technology, utilizing digital modulation and compression to efficiently transmit video, audio, and data signals. Antennas play a crucial role in this technology, with microstrip antennas being particularly notable for their compact size, ease of fabrication, and suitability for integration with other telecommunications equipment. The fabricated antenna measures 200 x 235 mm. By optimizing the Destructure Patch Element and Defected Ground Structure techniques, along with the addition of an Inset Feed, a wider bandwidth can be achieved, allowing for the reception of more digital television channels. At its working frequency, the fabricated antenna achieved a return loss of -36.8 dB, a bandwidth of 218.46 MHz, and a frequency range of 481.83 MHz to 700.29 MHz. The measured Voltage Standing Wave Ratio (VSWR) was 1.02, with a gain of 2.11 dBi at 538 MHz, 2.12 dBi at 546 MHz, 2.27 dBi at 626 MHz, and 2.3 dBi at 642 MHz. The radiation pattern was omnidirectional. Using a Vector Network Analyzer, the fabricated antenna was measured to have a return loss of -18.37 dB and a VSWR of 1.27. Additionally, digital TV broadcast testing was conducted, successfully receiving a strong and clear signal.**

Keywords— **Antena Mikrostrip, TV Digital, CST Studio Suite 2019, UHF**

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I. INTRODUCTION

At the beginning of its development,television broadcasting around the world was dominated by by analog technology. These analog broadcasts, which had been in use for several decades, transmits a relatively simple signal, but is limited in the picture and sound quality. As technology advanced and the demand for quality of broadcasting, the television industry began to switch to digital broadcasting. Digital television or digital broadcasting is a type of television that uses digital modulation and compression systems to broadcast video, audio and data signals to television sets [1]. data to the television set [1]. With this system, video, audio, and data signals can be transmitted to television more efficiently and with high quality. For the needs of this technology, a device that can work perform the digital TV communication function. One of the most important communication device that is very important is the antenna.

An antenna is a device designed to receive and transfer electromagnetic waves [2]. transfer electromagnetic waves [2]. Various kinds of antennas have been developed for various applications, one of which is the microstrip antenna. Microstrip antennas are antennas that use microstrip devices as antennas [3]. device as an antenna [3].Microstrip antennas have a light mass, are easy to be easy to fabricate so that it can be placed on almost any type of surface and is small in size compared to other types of antennas. small in size compared to other types of antennas, because of the properties that properties, microstrip antennas are very suitable for today's needs, so that can be integrated with other small telecommunications equipment [4].

Digital TV broadcasts operate in the 478 - 694 MHz frequency range [5]. In previous research, it can also be seen from the journal “Designing a Microstrip Rectangular Patch Antenna as a Television Receiver” (Anggit Yudha).

Rectangular Patch Microstrip Antenna as a Television Receiver" (Anggit Yudha Bagaskara, Bambang Bagus H, Romma Diana P), obtained a value of S1.1 of - 16.978 dB at a frequency of 700 MHz.16.978 dB at a frequency of 700 MHz with a bandwidth of 11 MHz. In this this final project, the authors design and build a microstrip antenna for digital television that has a wider bandwidth. television that has a wider bandwidth by optimizing the previous design, namely by using the the previous design by using the Destructure patch technique and the Defected Ground Structure technique.element and Defected Ground Structure (DGS) techniques so as to get a wider bandwidth. wider bandwidth. By using a microstrip antenna that has been optimized microstrip antenna, it is expected to capture more digital television channels.

II. METHOD

1. Materials and Tool

In this research, we designed a microstrip antenna. Before starting the design process, we need to understand the specifications of the antenna to be designed and calculate the dimensions of the microstrip antenna. Research Flow In the design of this final project, there are several stages that will be explained. Among them are stages that include calculating the operating frequency, antenna dimensions, VSWR, gain, and mathematical calculations for return loss. The second stage is the calculation of the width and length of the patch and the diameter of the ground plate. Furthermore, the dimensional design of the antenna is carried out using CST 2019 software. And the antenna fabrication process also requires a special liquid in the dissolution process later.

2. Anthenna Spesification

To make a microstrip antenna begins with determining antenna specifications, antenna calculations and design in CST Studio Suite 2019 software.antenna specifications, antenna calculation and design in CST Studio Suite 2019 software. .The results of the antenna design changes show that the antenna's working frequency is successfully widened using the Destructure Patch Element and Defected Ground Structure techniques to increase bandwidth. Parameter optimization is also carried out by adjusting the size of the antenna design, both by reduction and addition, to achieve optimal performance.The specifications of the antenna to be designed as in the table

TABLE 1
ANTENA SPESIFICATIONS

Specifications	Value
Work Frequency	478-694 MHz
VSWR	$1 \leq VSWR \leq 2$
Return Loss	< -10 dB
Gain	>2 dBi
Radiation Pattern	*Omnidirectional*

3. Antenna Design

Before designing a microstrip antenna,it is necessary to first determine the size of the antenna to be designed. To calculate and measure the specifications of the microstrip antenna using existing formulas. After doing the calculations to determine the size of the antenna can be seen in the table above. Patch Length (Lp) Patch Width (Wp), Feed1 Length (Lf), Feed1 Width (Wf), Feed2 Length (Lf2), Feed2 Width (Wf2).

TABLE 2
ANTENNA PARAMETER

Paramater	Value(mm)	Informtion
WidthSubstrate	235	Ws
LongSubstrate	200	Ls
WidthPatch	157.2	Wp
LongPatch	118.41	Lp
WidthGround	314.4	Wg
LongGround	236.82	Lg
WidthFeed	4.8	Wf
LongFeed	61.7	Lf
Width of Inset feed	1.5	Wif
Long of Inset feed	4.8	Lif
Width Tapered Side	50	Wtp
Long Tapered Side	65	Ltp

III. RESULT AND DISCUSSION

A. Design in CST STUDIO 2019

After calculating the parameters of the microstrip antenna, the next process is to design the antenna according to the parameters obtained using the CST Studio 2019 software. The next step displays the results of VSWR, return loss, polarization, and gain parameters.

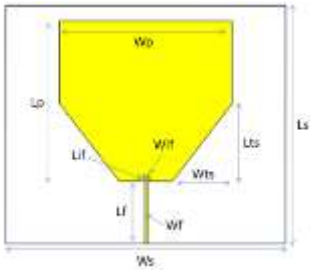

Fig.1 Front View Antenna Design (Patch)

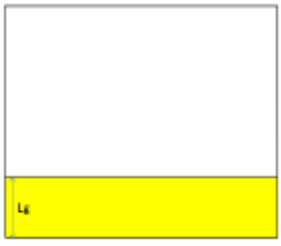

Fig.2 Design of the Antenna from the Rear View (Ground)

B. Fabrication Results

The fabricated antenna uses FR-4 substrate material with a thickness of 1.6 mm and is equipped with an SMA female connector. The fabrication process of this metamaterial patch antenna can be seen in the figure below, which shows the details of the structure and components used in making the antenna.

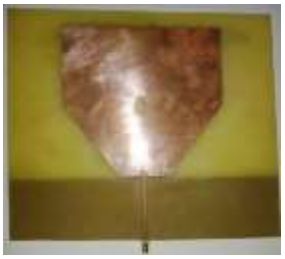

Fig.3 Pacht Fabrication Result

Fig.4 Ground Fabrication Result

C. Measurement Return Loss / S – Parameters

The return loss value of the optimization results is -36.8 dB with a frequency of 564.81 MHz. The return loss parameter optimization results are shown in Figure 4.1 below.
Figure 4.1 below.

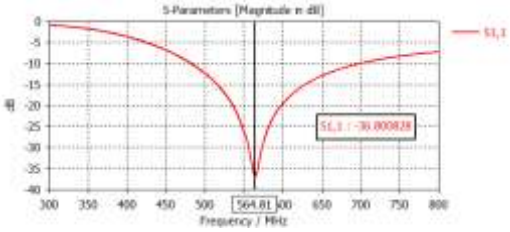

Fig.5 Results of S-Parameters Simulation

Hasil pengukuran *return loss* yaitu -18.37 dB pada frekuensi 625 MHz. Hasil pengukuran digambarkan dalam bentuk grafik 4.7 dibawah ini

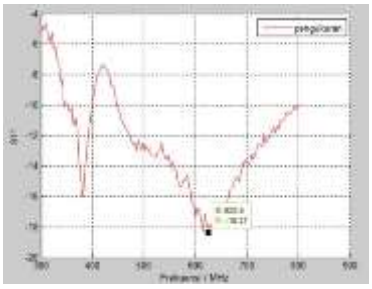

Fig.6 Return Loss Measurement graph

D. Voltage Standing Wave Rasio (VSWR)

The optimized VSWR value is 1.02 with a frequency of 564.81 MHz. Results return loss parameter optimization results are shown in Figure 4.2 below

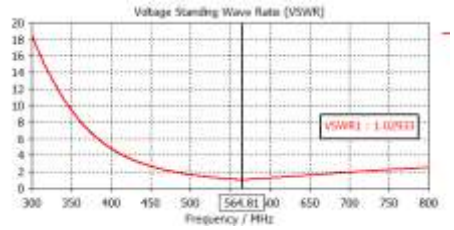

Fig.7 Results of VSWR Simulation

The VSWR measurement result is 1.274 at a frequency of 625.5 MHz. The VSWR measurement results are depicted in the form of graph 4.8 below.

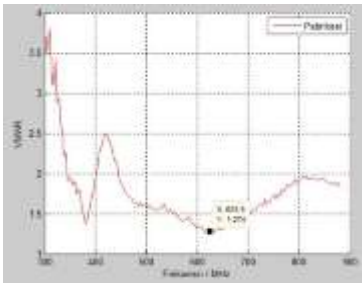

Fig.8 Results of VSWR Measurement

E. Gain

Gain is an antenna character with the ability to concentrate radiation antenna signal, or signal reception from a certain direction.In the figure 8 below can be seen the gain value obtained from the 4-channel simulation results.

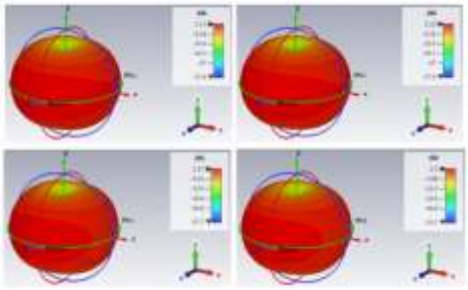

Fig.9 Simulation Results of Gain

Based on the picture above we can see that the gain value obtained on channel 29 frequency 538 MHz is 2.11 dB, on channel 30 frequency 546 MHz frequency is 2.12 dB, on channel 40 frequency of 626 MHz is 2.27 dB and on channel 42 frequency of 642 MHz is 2.3 dB. channel 42 frequency 642 MHz is 2.3 dB which is the red color above ndicates that the signal emission area comes from all directions of the theta plane of the antenna.

F. Bandwith

Bandwidth results are used to determine the performance of antennas that can operate well. operate properly. In Figure 10 below is a comparison of the bandwidth value of the microstrip antenna from simulation results and antenna fabrication.

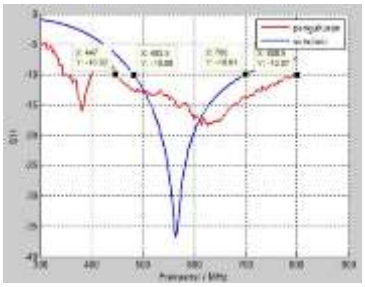

Fig.10 Bandwidth Comparison of Fabrication Results with Simulation Results

From the picture above, it can be seen that for the simulation results the bandwidth value is 217.5 MHz while for the fabrication results the bandwidth value is the bandwidth value is 217.5 MHz while for the fabrication results the bandwidth value is 353.5 MHz, which for the bandwidth value of the fabrication results is wider than the bandwidth value of the simulation results. compared to the bandwidth value of the simulation results. This can be caused by physical dimensional changes in the initial design that can inadvertently increase the antenna bandwidth

G. Measurement of Radiation Patterns

The radiation pattern displayed in Figure 11 for the digital TV broadcast signal receiver is omnidirectional.digital TV broadcast signal receiver, the radiation pattern obtained is omnidirectional which has an which has a transmitting direction in all directions and is produced by an isotropic antenna,as seen in Figure 11 below.

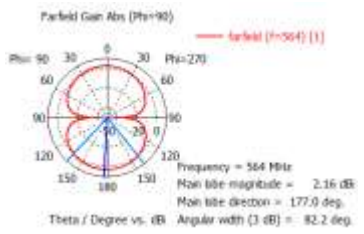

Fig.11 Antenna Radiation Pattern Results

H. Comparison of Simulation and Fabrication Design Results

Parameters	Simulation Result	*Fabrication Result*
Return Loss	-36.8 dB	-18.37
VSWR	1.02	1.274
Gain	2.11-2.3	-
Bandwith	218.46 MHz	353.5 Mhz
Radiation Pattern	Omnidirectional	-

IV. CONCLUSION

In this final project, a microstrip antenna for digital television receivers has been made.receiver. After carrying out the process of design, simulation, optimization, and fabrication of the antenna, it can be concluded that on the antenna, the following conclusions can be drawn:

1. Microstrip antenna designed using CST Studio softwareSuite 2019 software resulted in antenna dimensions of 200 x 235 mm2 by using a substrate of 1.6 mm thick double layer FR-4 material. mm thick.

2. Optimal antenna design is achieved through optimization of patch size, feedline, groundplane, substrate, and application of the Destructure Patch Element technique, resulting in a bandwidth wide enough to cover digital television broadcast frequencies in Indonesia.digital television in Indonesia.

3. The results of the optimized antenna parameters are return loss = - - 36.8 dB, VSWR = - - 36.8 dB.36.8 dB, VSWR = 1.02, gain = 2.11 -2.3 dBi, bandwidth = 218.46 MHz, and radiation pattern = omnidirectional. As for the results of the antenna parameters in the measurement are return loss = -18.37 dB, VSWR = 1.274, and bandwidth = 353.5 MHz.

4. The simulated and fabricated antenna results show that the specifications of the tenna parameters for digital television receivers such as bandwidth,return loss, VSWR, and gain have met the expected specifications.

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