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2017 International Conference on Radar, Antenna, Microwave,
Electronics, and Telecommunications (ICRAMET)
Jakarta, Indonesia, 23-24 October, 2017

Program Schedule

Day 1 (October 23rd, 2017)

08.00 – 09.30 **Registration**

09.30 – 10.00 **ICRAMET Opening Ceremony**

09.30 - 09.40 Conference Chair Remark

Dr. Natalita Maulani Nursam, MPhil

09.40 - 09.50 IEEE Indonesia Section Remark

IEEE Indonesia Section Representative

09.50 - 09.55 Opening Remark

Dr. Purwoko Adhi, Dipl.Ing., DEA

09.55 - 10.00 Photo session

10.00 – 10.30 **Coffee Break**

10.30 – 11.15 **Keynote Session 1**

Moderator: Dr. Yusuf Nur Wijayanto;
Assistant: Yahya Syukri, ST

Metamaterials and Metasurfaces at Microwaves and Beyond

Dr. David A. Powell
University of New South Wales, Australia

11.15 – 12.00 **Presentation Session- Day 1 Session 1**

Moderator: Yana Taryana, MT; Assistant: Yahya Syukri, ST

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Digital Pre-distortion using Legendre Polynomials for Band 25 Transmitters

Ajit Reddy

11.30 – 11.45 PS-1.1.02

Compact FMCW Radar system for Navigation Application -Transmitter Sub System Design

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Preliminary Study on Absorption Rate of Truncated Wedge Biomass Microwave Durian Absorber

Hasnain Abdullah, Azwati Azmin, Yuzairi Yusoff, Aiza Mahyuni Mozi, Najwa Rawaida Ahmad, Ahmad Rashidy Razali, Mohd Nasir Taib

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Moderator: Ir. Mashury Wahab, M.Eng;
Assistant: Sulistyaningsih, M.Eng

Compressive Sampling in Radar and Related Fields

Prof. Andriyan Bayu Suksmono, Ph.D
Institut Teknologi Bandung, Indonesia

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Assistant: Chaeriah Bin Ali Wael, MT

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Review of Deep Convolution Neural Network in Image Classification
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14.30 – 14.45 PS-1.2.04
FPGA-based Implementation of Orthogonal Wavelet Division Multiplexing
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14.45 – 14.55 Poster Session- Flash Poster Presentations
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POS.03
Image Edge Detection using Objective Function and Fuzzy C Means
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POS.04
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Assistant: Prasetyo Putranto, ST

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Arief Nur Rahman, Octa Heriana, Prasetyo Putranto, Fajri Darwis, Eko Joni Pristianto, Yusuf Nur Wijayanto

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Assistant: Putri Nur Anggraini, SSi

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Asisstant: Chaeriah bin Ali Wael, MT
MEMS and Microfluidic: Interfacing Macro and Nanoworld
Prof. Dato' Dr. Burhanuddin Yeop Majlis, D.P.M.P., J.M.N., FASc, FIET, FMSSS, SMIEEE
Institute of Microengineering and Nanoelectronics(IMEN)
Universiti Kebangsaan Malaysia

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Moderator: Dr. Yuyu Wahyu;
Assistant: Putri Nur Anggraini, SSi
The Development of Microstrip Antenna and Its Applications – An Overview
Prof. Eko Tjipto Rahardjo
University of Indonesia, Indonesia

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13.45 – 14.00 PS-2.2.04
Stacked Rectangular Ring Slot Microstrip Antenna with Parasitic Load for UMTS, LTE and WiFi Applications
Indra Surjati, Yuli Kurnia Ningsih, Syah Alam

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Arie Pangesti Aji, Catur Apriono, Fitri Yuli Zulkifli, Eko Tjipto Rahardjo

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Profiling Subscriber Dynamic Database of Mobile Communication of LTE Network Co-exist with 2G and 3G Network

Bobby Juan Pradana

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Automated Ship Detection with Image Enhancement and Feature Extraction in FMCW Marine Radars

D. Yulian, R. Hidayat, H. A. Nugroho, A. A. Lestari, F. Prasaja Putera

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15.30 – 16.15 Presentation Session- Day 2 Session 3

Moderator: Hana Arisesa, ST; Assistant: Sulistyaningsih, MT

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Ajib Setyo Arifin and Dimas Agung Prasetyo

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Hairpin Line Bandpass Filter for 1.8 GHz FDD-LTE eNodeB Receiver

Muhammad Fadhil, Heroe Wijanto, Yuyu Wahyu

16.00 – 16.15 PS-2.3.03

Light LED Directly Lit up by the Wireless Power Transfer Technology

Mohamed Zied Chaari and Rashid Rahimi

16.15 - 16.30 Closing and Award Ceremony

Stacked Rectangular Ring Slot Microstrip Antenna with Parasitic Load for UMTS, LTE and WiFi Applications

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***Abstract*—This paper proposes a new design of stacked rectangular ring slot microstrip antenna using parasitic load with slits and fed by coplanar waveguide. The measurement results shown return loss of -14,94 dB with VSWR 1,44 at frequency 2100 MHz for UMTS, at frequency 2300 MHz for LTE produce return loss -21,21 dB with VSWR 1,19 and return loss of -21,81 dB with VSWR 1,18 at frequency 2400 MHz for WiFi application.**

***Keywords*—Stacked; peripheral slit; parasitic; coplanar waveguide.**

I. Introduction

Information technology is developing rapidly, especially in wireless telecommunication. The people's need for speedy data transfer process resulted in many telecommunication providers to optimize their network in order to meet customer needs. On side of the users, they require a receiver device that can operate on a wide bandwidth in order to function in available telecommunication systems. In [1], some of these frequency allocations are: UMTS in the frequency band 1920-2170MHz, WLAN 2.4 GHz in the frequency band 2400-2483.5 MHz and LTE at 2.3 GHz.

To fulfil the need, an antenna that can support such wireless communication is needed. One type of antenna that is currently widely used for wireless communication is microstrip antenna. Microstrip antennas have advantages such as small size, compact, and simple. However, this type of antenna has several deficiencies, including low gain and narrow bandwidth [2]. One way to overcome the narrow bandwidth and small gain is by optimizing the microstrip antenna. One method of optimization is the stacked method, which is a method of stacking the microstrip antenna on several substrates that will result in the increase of bandwidth value of the antenna [3].

In previous study by [4], there was an increase of bandwidth by 52.13% at working frequency 4.85 GHz – 8.27 GHz by using circular polarization microstrip antenna optimized by stacked method and direct feeder line. From another study conducted by [5], the result was 45% increase in bandwidth at the working frequency of 2.86 to 4.63 GHz using rectangular microstrip antenna with stacked method and direct feeder line. While [6] in their study successfully performed bandwidth optimization by 6.58% at 2.46 GHz working frequency and 8.52% at 2.6 GHz working frequency by using rectangular antenna stacked with 2 substrate and indirect feeder line. In the other studied [7-13], parasitic load succeed to enhanced bandwidth of microstrip antenna.

In this study, a microstrip antenna was designed using stacked method with parasitic load fed by coplanar waveguide (CPW) for application on UMTS (2100 MHz), LTE (2300 MHz) and WiFi (2400 MHz). The design is expected to be able to operate for all three applications so that it can be used for telecommunication devices.

II. Antenna Design

The antenna patch was designed using two substrates with dielectric constant (εr) = 4.3, substrate thickness (h) = 1.6 mm and tangential losses (tan δ) = 0.0265. The dimension of the rectangular patch antenna was calculated using the following formula:

$$L = W = \frac{c}{2 f_o \sqrt{\varepsilon_r}} \tag{1}$$

As for calculating the rectangular ring slot, the following formula was used, where L1 is the outer dimension of the patch and L2 is the inner dimension of the patch.

$$fr = \frac{c}{2(L1 + L2)} \sqrt{\frac{1+\varepsilon_r}{2\varepsilon_r}} \tag{2}$$

The dimensions of the coplanar waveguide (CPW) feeder line was calculated using the help of microstrip line software to obtain the CPW dimension values corresponding to antenna output impedance value of 50 Ohm, as presented in Table I.

In the CPW line there were three lines, namely one line that was connected directly to the patch and two lines that were connected to ground. The gap between the feeder line and ground determined the impedance characteristic value of the antenna.

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TABLE I. COPLANAR WAVEGUIDE LINE DIMENSION

Parameter	Specifications
Line conductor width (*w*)	2.67 mm
Line slit width (*s*)	1 mm
Effective permittivity	3.010
CPW line length (*f*)	4.1 mm
Ground Plane length *(lg)*	2.5 mm
Characteristic impedance	50.014 ohm

On the antenna patch, a load slot was added on the inner of the patch to increase the bandwidth.

To get a wider bandwidth, then the next stage was designing the parasitic load. The given parasitic load has the same W and L dimensions as the inner patch of the rectangular ring slot antenna. To gain a maximum bandwidth value, and then slit gaps were given on the parasitic load. The parasitic load was at the top layer while the rectangular ring antenna with CPW feeder is in the lower layer. The purpose of the parasitic load was to optimize the antenna bandwidth so that the antenna can be used for applications at 2100 MHz, 2300 MHz and 2400 MHz frequencies. The designs of the stacked microstrip antenna with the parasitic load are presented in Figs. 1 and 2.

III. RESULT AND DISCUSSION

The geometry of the rectagular ring slot antenna with CPW lines after iterated is presented in Fig. 3.

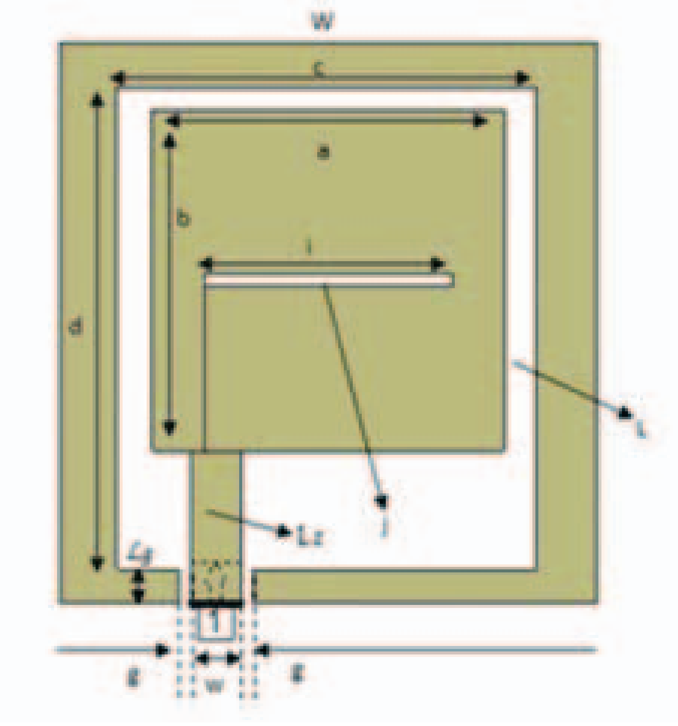

Fig. 1. Patch antenna in the lower layer.

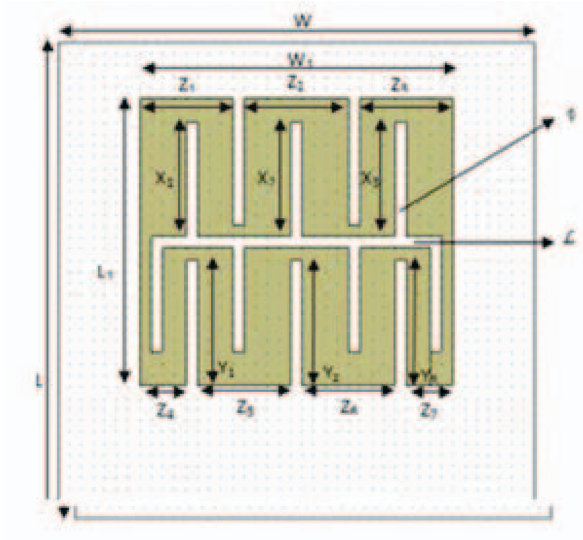

Fig. 2. Parasitic load in the top layer

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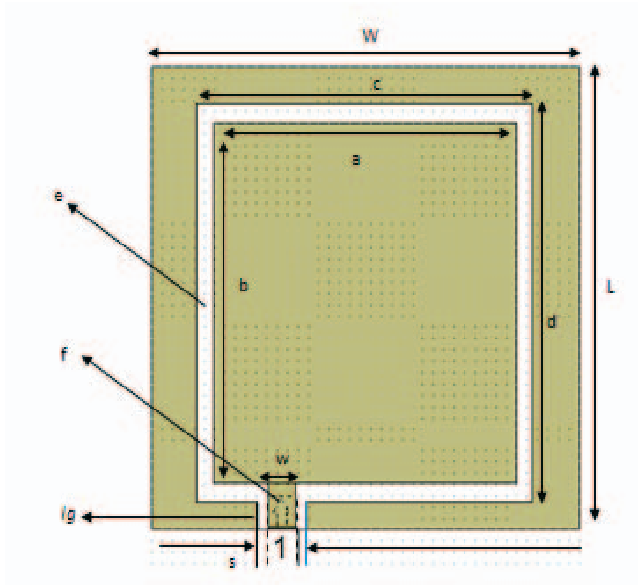

Fig. 3. Rectangular ring slot antenna with CPW feeder.

Table II presents the dimensions of the rectangular ring slot antenna that was fed by CPW lines. Fig. 4 and 5 present the return loss and VSWR simulation results of the antenna.

From Figs. 4 and 5, it can be seen that the antenna return loss value at 2100 MHz frequency is -10.19 dB, at 2300 MHz frequency is -18.95 dB and at frequency 2400 MHz is -12.57 dB. The antenna’s bandwidth is 353 MHz with frequency range of 2096 MHz - 2449 MHz. For VSWR value can be seen in Fig. 5 where the value of VSWR at 2100 MHz frequency is 1.899 while at 2300 MHz frequency is 1.254 and at 2400 MHz frequency is 1.617.

TABLE II. COPLANAR WAVEGUIDE LINE DIMENSION

Parameter	Dimension	Information
W	41 mm	Width of substrate
L	41 mm	Length of substrate
a	29 mm	Length of inner patch
b	32 mm	Wide of inner patch
c	32,2 mm	Length of outer patch
d	35,2 mm	Width of outer patch
e	1,6 mm	Wide of slot
f	4,1 mm	Length of slot
lg	2,5 mm	Length of ground plane
s	1 mm	Gap between feeder and ground plane
w	2,7 mm	Width of feeder line

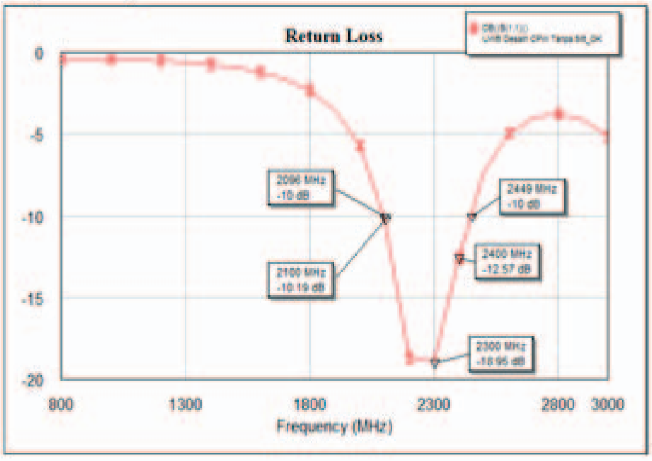

Fig. 4. Simulation result of return loss.

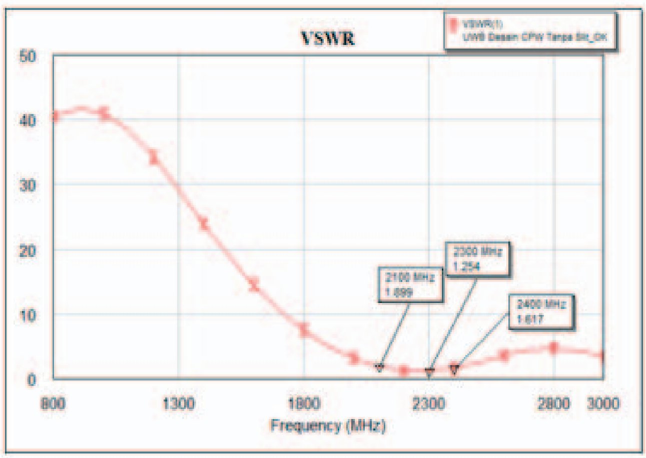

Fig. 5. Simulation result of VSWR.

To obtain the best simulation result of parameter value of antenna it will be an iteration process by adjusting the length and width of the slit on the parasitic load. The iteration can be seen in Table III. Figs. 6 - 9 present the results of the simulated return loss of the parasitic load.

TABLE III. ITERATION OF PARASITIC LOAD

Iteration	Parameter *(mm)*						
	X1	*X2*	*X3*	*Y1*	*Y2*	*Y3*	*Ws*
1	8	8	8	9	9	9	1
2	10	10	10	11	11	11	1
3	8	8	8	9	9	9	2
4	10	10	10	11	11	11	2

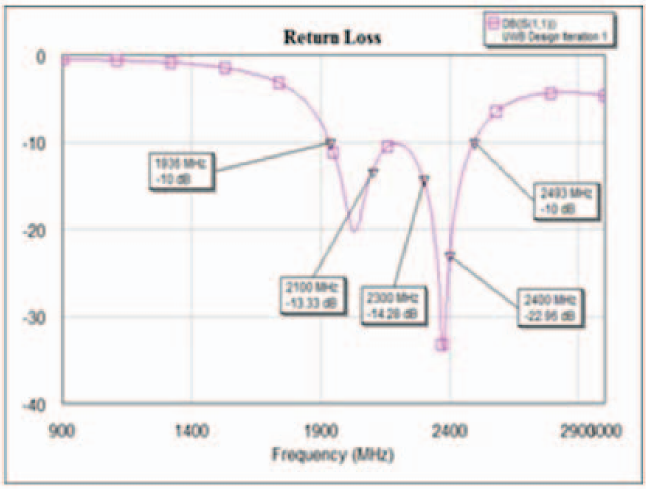

Fig. 6. Results of return loss in iteration 1.

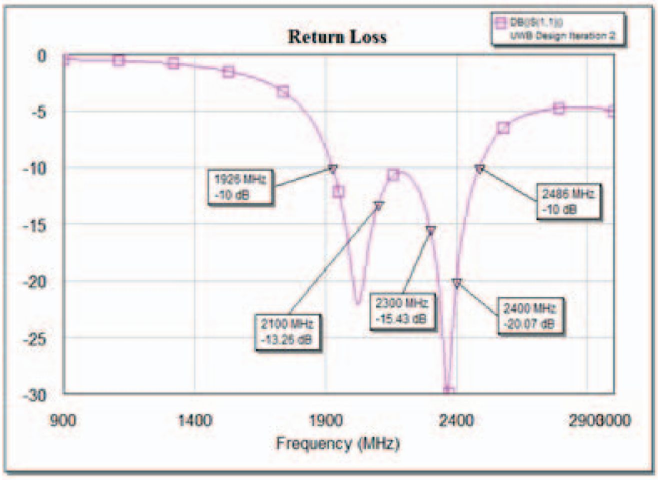

Fig 7. Results of return loss in iteration 2.

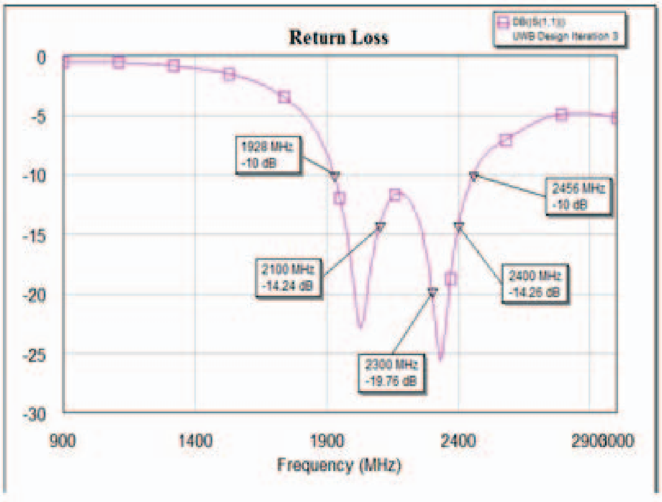

Fig. 8. Results of return loss in iteration 3.

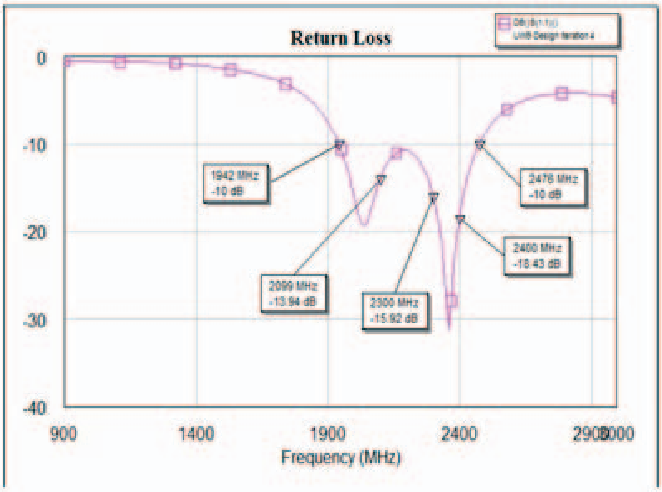

Fig. 9. Results of return loss in iteration 4.

In the second iteration, it is seen that the resulting bandwidth is 560 MHz (1926 MHz - 2486 MHz). It can be concluded that the microstrip antenna design was able to operate in the expected working frequency range of 2100 for UMTS, 2300 for LTE and 2400 MHz for WiFi.

Table IV shows the bandwidth simulation results of the design of the stacked rectangular ring slot antenna with parasitic load.

TABLE IV. BANDWIDTH OF STACKED RECTANGULAR RING SLOT ANTENNA

Iteration	Parameter	
	Frequency Range	**Impedance Bandwidth**
1	1936 – 2493 MHz	557 MHz
2	1926 – 2486 MHz	560 MHz
3	1928– 2456 MHz	528 MHz
4	1942 – 2476 MHz	534 MHz

After the parasitic load iteration process and maximum bandwidth was obtained, the next step was to fabricate the microstrip antenna. The designed microstrip antenna was fabricated on two substrate layers as shown in Figs. 10 and 11. After the fabrication, the next step was the measurement of the antenna as shown in Figs. 12 and 13.

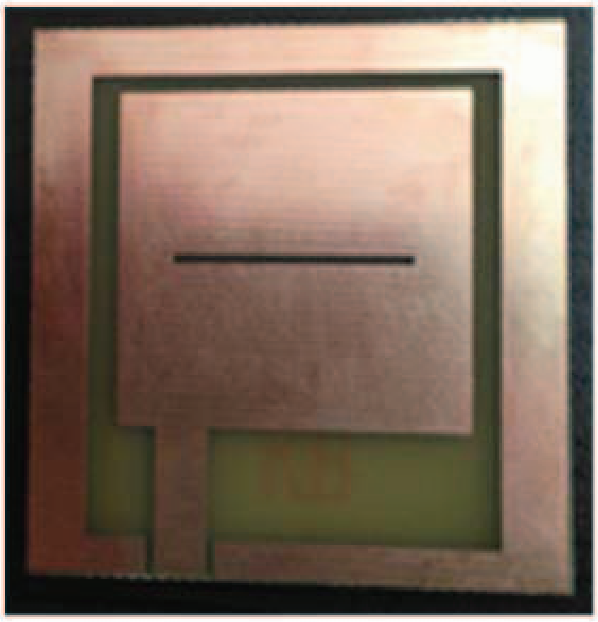

Fig. 10. Rectangular ring slot antenna on the lower layer.

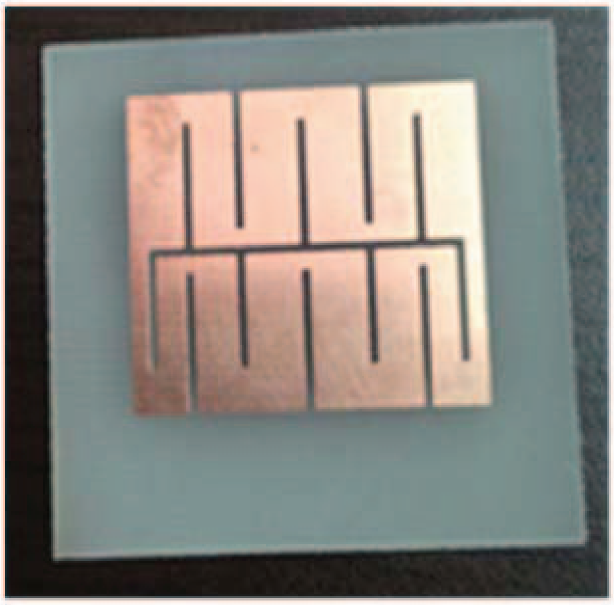

Fig. 11. Parasitic loads on the top layer.

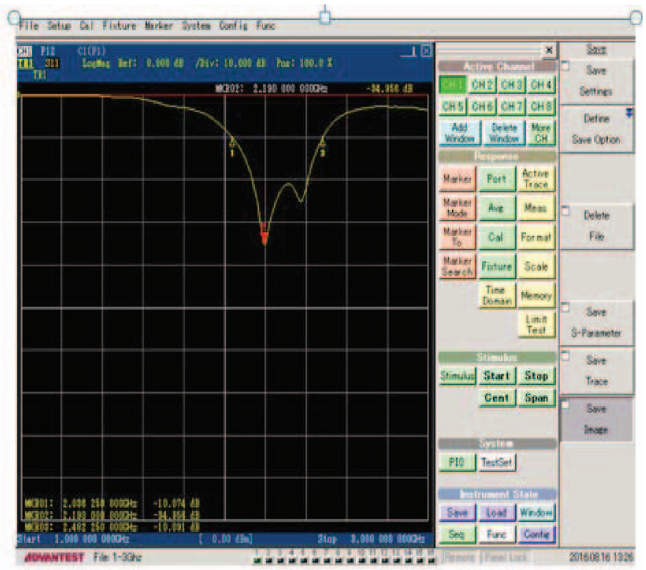

Fig 12. Antenna returns loss measurement results

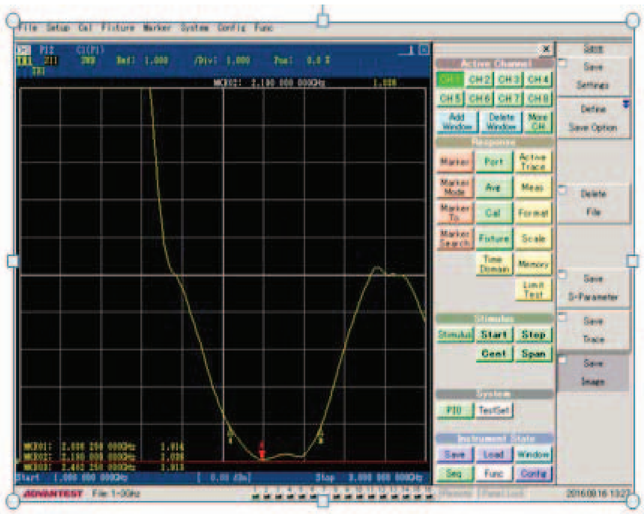

Fig. 13. Antenna VSWR measurement results.

Table V presents the comparison of the simulation results with the measurement results of the antenna design. From Table V shows that the measurement results are better than the simulation results. Fig. 14 presents the comparison of the return loss value of the simulation and the measurement results.

TABLE V. COMPARISON OF RETURN LOSS RESULT IN SIMULATION AND MEASUREMENT

No	Working Frequency	Return Loss Simulation (dB)	Return Loss Measurement (dB)
1.	2100 MHz	-13.26	-14.94
2.	2300 MHz	-15.43	-21.21
3.	2400 MHz	-20.07	-21.81

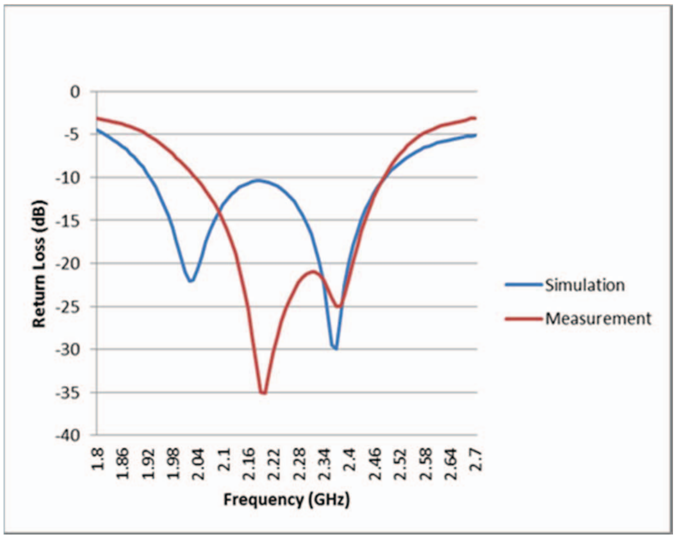

Fig 14. Comparison of return loss values in simulation and measurement

In Fig. 14, it can be seen that in the measurement results obtained a narrow bandwidth compared with the simulation. From the simulation results, the obtained bandwidth was 560 MHz (1926 - 2486 MHz), while from the measurement the bandwidth obtained was 440 MHz (2040 MHz - 2480 MHz).

Fig. 15 presents the comparison of VSWR simulation results with the measurement results, whereas Table VI shows the value of the comparison. Fig. 16 shows the results of the radiation pattern measurement of the antenna. It is seen that the radiation pattern is broadside with HPBW value of 80°.

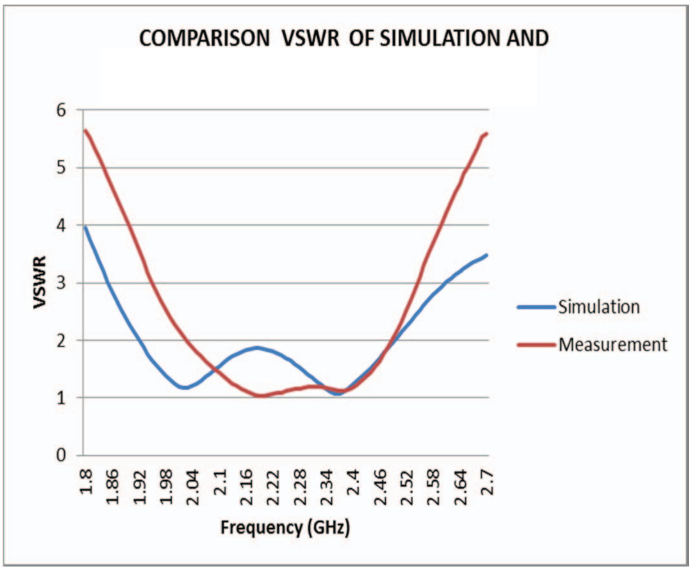

Fig. 15. Comparison of VSWR values in simulation and measurement.

TABLE VI. COMPARISON OF VSWR VALUE IN SIMULATION AND MEASUREMENT

No	Working Frequency	VSWR in Simulation	VSWR in Measurement
1.	2100 MHz	1.55	1.44
2.	2300 MHz	1.40	1.19
3.	2400 MHz	1.22	1.18

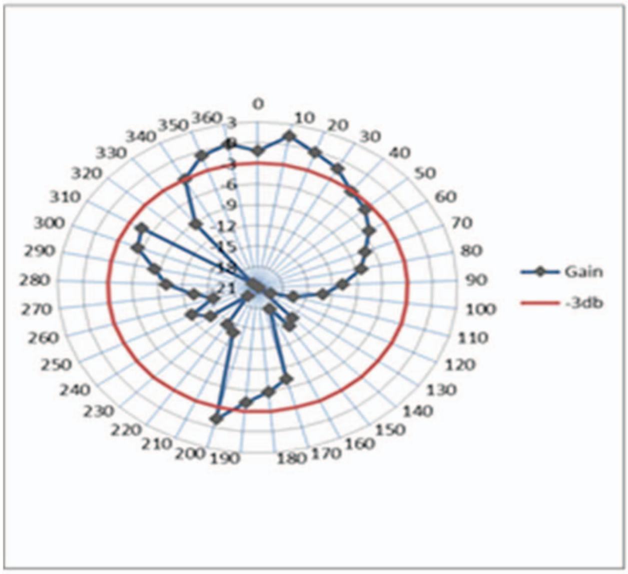

Fig. 16 Results of antenna radiation pattern measurement.

From the Table VI we can see that the measurement result is better than simulation result, this is due to the antenna fabrication results still have less accuracy. Furthermore, the use of substrate type FR4 is very difficult to get the value according to the simulation because it has a considerable loss tangent about 0.0265 so that when the measurement process obtained the results shifted or reduced. From the overall result, the working frequency value of designed microstrip antenna has shifted at measurement process compare with simulation result but still in good category and still can be used for UMTS, LTE and WiFi.

IV. CONCLUSION

A new design of stacked rectangular ring slot microstrip antenna with parasitic load is eventually well proposed.The simulation obtained return loss value at 2100 MHz working frequency was -13.26 dB with VSWR 1.55 at 2300 MHz working frequency, the return loss value was -15.43 dB with VSWR 1.40 and at the working frequency of 2400 MHz, return loss value was -20.07 dB with VSWR 1.22. From the results of measurement at frequency 2100 MHz return loss value obtained was -14,.94 dB with VSWR 1.44 , at working frequency 2300 MHz the return loss value obtained was -21.21 dB with VSWR 1.14 and at working frequency 2400 MHz return value was -21.81 dB with VSWR 1.18. The bandwidth obtained from the simulation results was 560 MHz (1926 - 2486) MHz, while from the measurement results was 440 MHz (20140 - 2480) MHz. From the radiation pattern test results, the radiation pattern type was broadside with HPBW of 80°. From the overall simulation and measurement results, it can be concluded that stacked rectangular ring slot microstrip antenna can operate well for UMTS, LTE and WiFi application frequencies.

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