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Parallel Integrated Switch Operation Mode Rectenna (ISOMR) Device for Television

Wahju Adi Priyono[1], Rudy Yuwono[2], Eva Faliha Kusumawardhany[3], Raihan Tantyo Putra[4] and Muhammad Fahreza Kresnamurti[5]

[1]Computation and Network Laboratory, Brawijaya UniversityMT. Haryono 167, Malang 65145, Indonesia
[2,4] Transmission and Microwave Laboratory, Brawijaya University MT. Haryono 167, Malang 65145, Indonesia
[3,5]Telecommunication Laboratory, Brawijaya University MT. Haryono 167, Malang 65145, Indonesia
Corresponding Author : wajuepie@ub.ac.id, rudy_yuwono@ub.ac.id, evafalihak@gmail.com, raihantyp@gmail.com, rezafiel@gmail.com

Abstract

This paper explains about energy harvesting using electromagnetic that's been transmitted by TV station. The main tool of this energy harvesting method is Rectenna. Rectenna is a combination from antenna and rectifier. Antenna is used to received electromagnetic wave then rectifier is a device that used to transform AC signal into DC signal. For the receiver antenna we use clover-shaped microstrip antenna. And for the rectifier is made from four diodes 1N60 germanium glass, an antenna port television, and an electrolytic capacitor 10uF. Integrated Switch Operation Mode Rectenna (ISOMR) it's needed to not interference TV antenna's performance. Using two Integrated Switch Operation Mode Rectenn (ISOMR) parallel will produce 36.4mV voltage. Single Integrated Switch Operation Mode Rectenna (ISOMR) will produce 17.2 mV voltage.

Keywords*: Harvesting energy, Integrated Switch Operation Mode Rectenna (ISOMR), electromagnetic, rectenna, rectifier, antenna*

1. Introduction

Energy harvesting is the process by which energy is derived from external sources. Energy harvesting research that use ambient energy (ex. Light, electromagnetic wave, heat) is getting popular. This method is expected to exploit available potential energy on environment. Current developed research is motivated from wasted electromagnetic wave that available surrounds.

Harvesting energy by collecting electricity or power from telecommunication systems is expected as a new power source. For example, the energy of electromagnetic waves collects from broadcast TV, radio, and cellular base stations.

Energy Harvesting is a process that collect the energy that arise from some process, where the energy can be saved for some times and can be controlled so that can be used on the other time. Energy harvesting can use electromagnetic wave that transmitted by TV station.

Rectenna has an important role in wireless energy harvest because it collects the electromagnetic radio frequency energy from free space and converts it into useful dc power. The Rectenna device is proposed in the context of energy harvesting applications to achieve low-consumption wireless sensors or sensor networks [2-6,91-10]. Rectenna is

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a combination from antenna and rectifier. Antenna uses to received electromagnetic wave. Rectifier is a device that used to transform AC signal into DC signal. So rectenna can be use to convert electromagnetic wave that have been received by antenna to be DC current that makes rectenna allows to get electrical power from electromagnetic wave surround. But however, rectenna has side effects on the performance of the antenna of television or radio itself.

Therefore, it is necessary for the switch. so when the television or radio is on rectenna can work without disturbing the surrounding device and when the television or radio turns rectenna will off so that the performance of the television and radio antenna is not interrupted. Switch Operation Mode (SOM) is a switching method on an electronic device. This automatic switch can be useful for rectena use because it can change the position of the switch automatically. Integrated Switch Operation Mode (ISOM) is intended to make switches that can be used on television more easily.

All this time that have been many research regarding controlling circuit position by using several parallel antenna. regarding relation of controlling circuit position with parallel antenna, can be found on this paper.

2. Related Researches

2.1. Antenna Design

Rectenna has two components, there are antenna receiver and a rectifier. The receive antenna is a clover-shaped microstrip antenna with the substrate of FR-4 and patches made from copper. below is the design of our microstrip antenna:

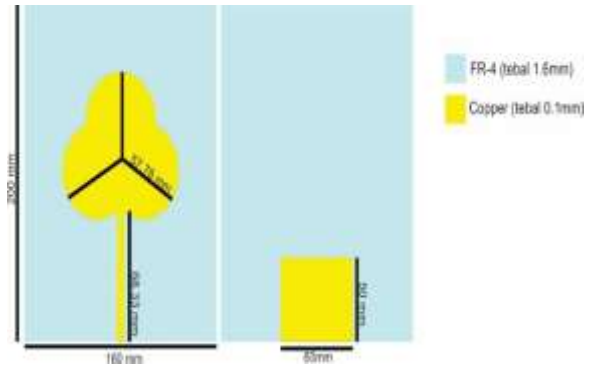

Figure 1. Design of Microstrip Antenna Using the CST Microwave Studio

2.2. Rectifier Design

A rectifier is made from four diodes 1N60 germanium glass, an antenna port television, and an electrolytic capacitor 10uF. The rectifier use diode 1N60 germanium glass because it is corresponds to the frequency of the television antenna. The rectifier is used to convert AC voltage to DC voltage. So the voltage can be stored and measure on the capacitor. The schematic of rectifier that has been designed using eagle software is shown below:

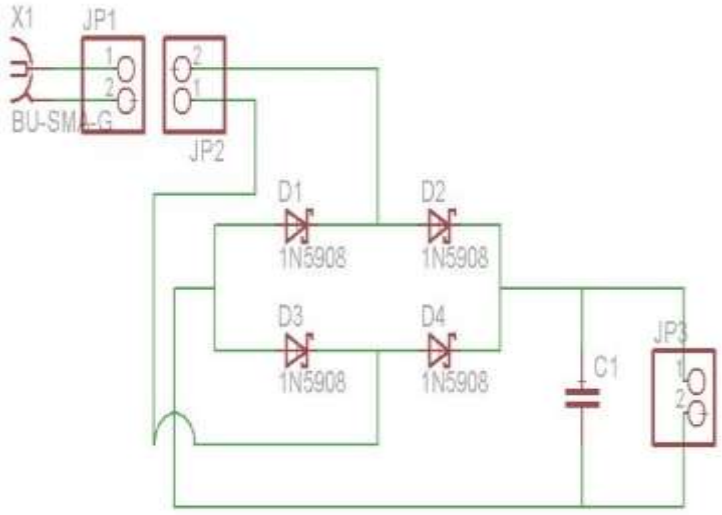

Figure 2. Schematic of Rectifier

2.3. SOMR Design

This is the design of SOMR. All components must be unified and we combine them using this design. This circuit incorporates all the required components in one circuit. This circuit intend to make the switch automatically so when the TV is ON this device will goes OFF and when the the TV is OFF this devicce will goes ON automatically.

In Figure 3 is SOMR design is created by eagle software.

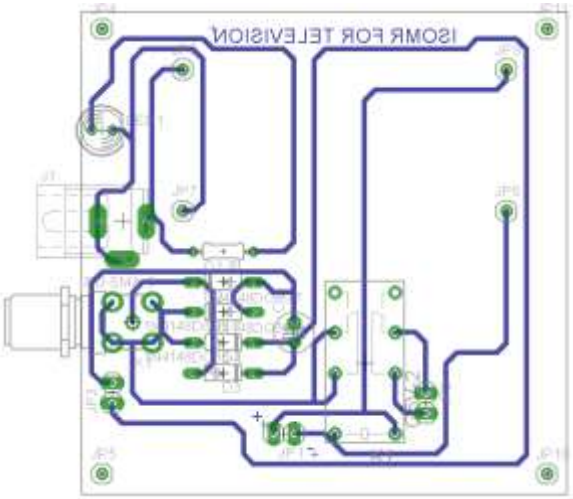

Figure 3. SOMR Design

2.3. SOMR Case Design

We make the design make thing easier, easy to use, easy to remove, easy to install, easy to read. The antenna port we use is SMA port follow the antenna that we design. Indicator light to make it easier to read. Tv connecetor to synchronieze the state of the TV and the ISOMR. Pin header for the measurement and powerbank input.

In Figure 4 is SOMR design, the design is created by Corel draw

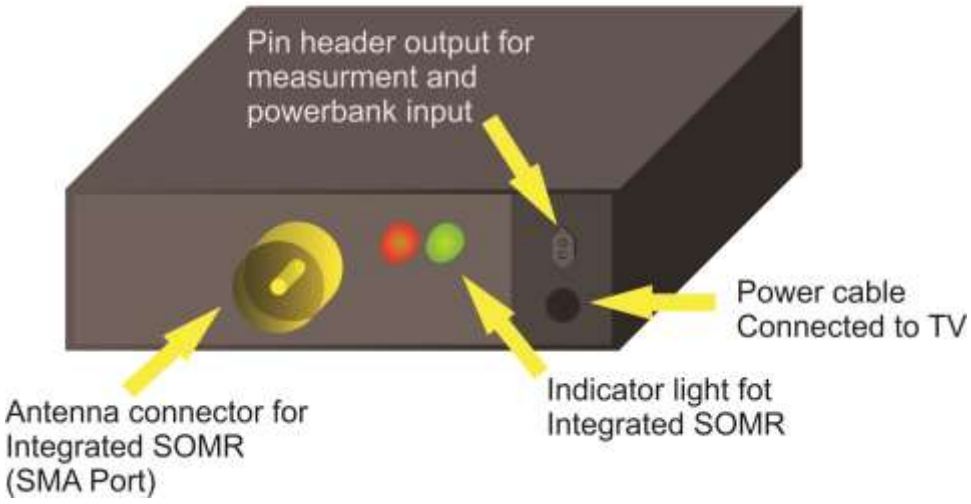

Figure 4. SOMR Case Design

3. Measurement

The measurement mechanism of SOMR for Television is shown below:

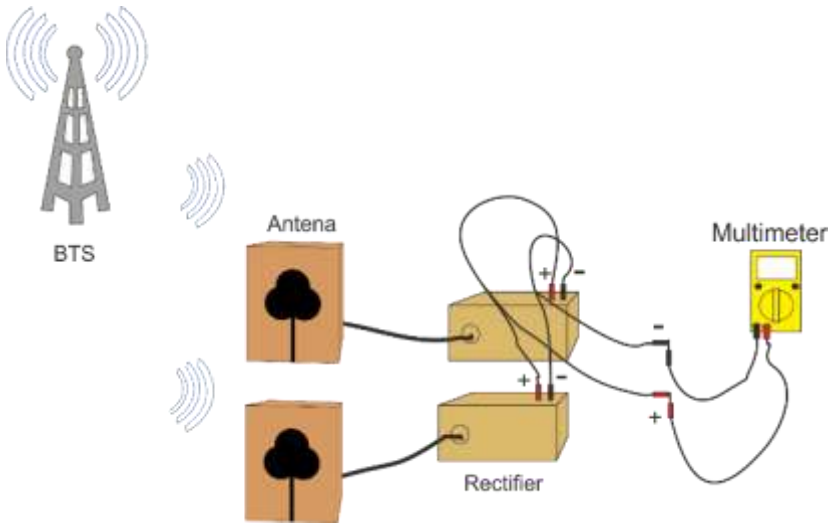

Figure 4. The Measurement Setup for Parallel SOMR

In Figure 4 it can be explained that the Base Transreceiver Station (BTS) which is a telecommunication network device that facilitates wireless communication between device and network. Base Transreceiver Station (BTS) are use for transmitting radio signals. So antenna is use for receiving electromagnetic waves emitted by Base Transreceiver Station (BTS). Then the antenna is connected with rectifier. Rectifier used to convert the AC signals to DC signals. Combination of antenna and rectifier is called rectenna. The rectenna is connected by parallel in this experiment. Then these two rectenna are conenected to the multimeter to measure the output voltage by the rectenna.

Design of a microstrip antenna using CST should consider some measurement results. VSWR is one of the parameter to be considered when designing an antenna. VSWR measurement results as graphs in Figure 5 below:

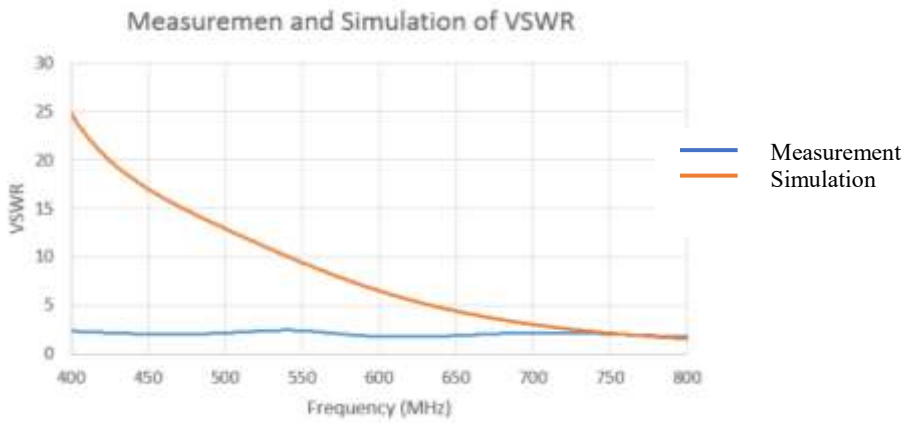

Figure 5. VSWR

Voltage Standing Wave Ratio (VSWR) is the ratio of maximum and minimum on a wave due to the reflection caused by not match between input impedance with feeder channel. In figure 5 VSWR obtained when the good simulation is approximately close to 2. When the measurement VSWR is stabile close to 2 in frequency of 400-800 MHz.

3.1 Measurement Setup

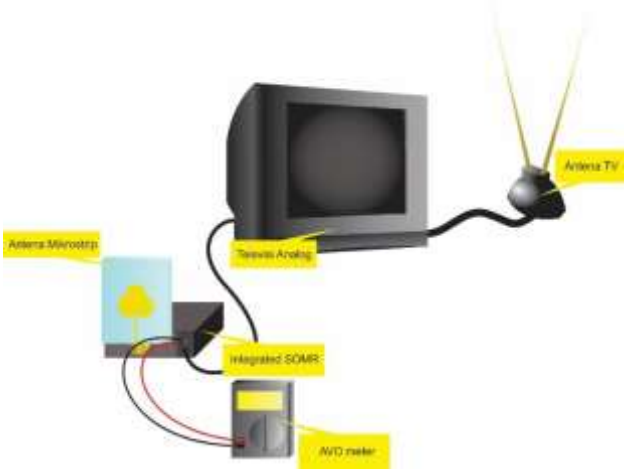

Figure 6. Measurement Setup for SOMR

In figure 6 is measurement setup for Switch Operation Mode Rectenna (SOMR). The antenna is connected with Switch Operation Mode Rectenna (SOMR). Then to measure the current and voltage using AVOmeter. Avo meter use to measure the current and voltage from the Switch Operation Mode Rectenna (SOMR). Then the output of integrated SOMR is connected to analog television. Analog television is connected with a television antenna.

3.2 Result

Current Output = 0.182 mA
Voltage Output = 36.4 mV

Figure 7. SOMR Voltage

In Figure 7 is the result of measurement using avometer. The resulting voltage is 36.4 Mv and the current is 0.182 Ma. Return to loss for HF frequency is shown below:

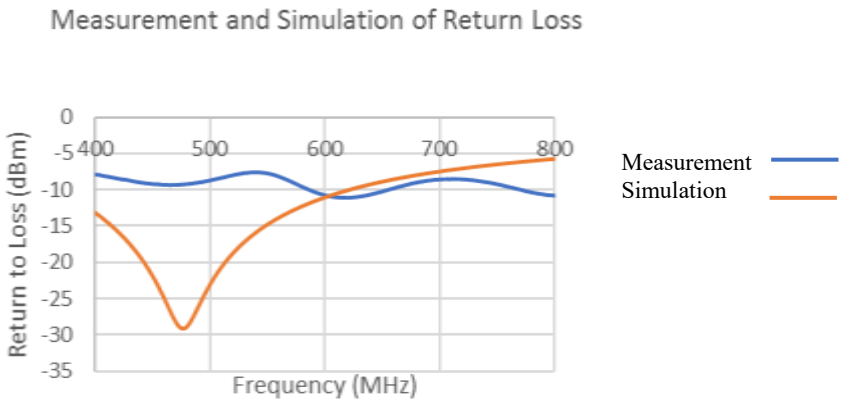

Figure 5. Return Loss

In Figure 5 is the graphic of return loss. Return loss is used in modern preference to Standing Wave Ratio (SWR). Because it has better resolution for small values of reflected wave. The good return loss is ≤ -10 Db. In the measurement this Return loss is ± ≤ -10 Db. Then in the simulation the return loss is more good in 800 MHz.

Gain is another parameter obtained from the result of antenna performance measurement. Figure 6 is the result of gain measurement on microstrip antenna:

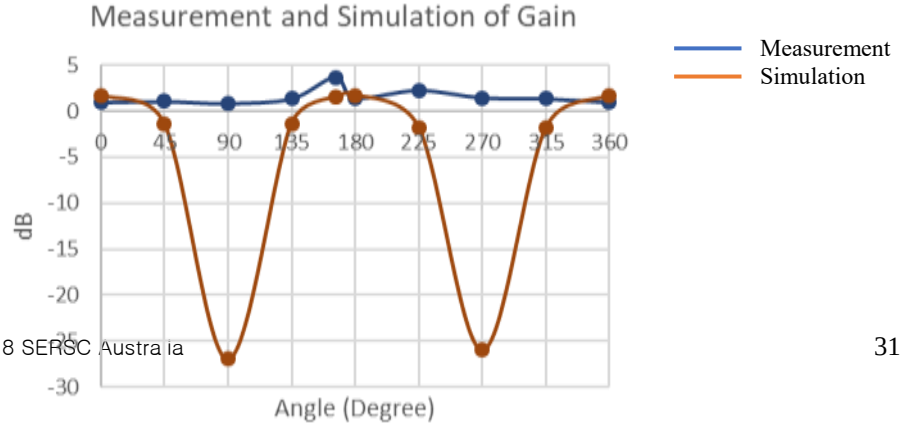

Figure 6. Gain

In figure 6 is the graphic of gain. Gain by simulation is not stabile then gain by measurement is ± 1

Radiation patterns form an omnidirectional pattern that almost forms an isotropic pattern, as shown on figure 7 :

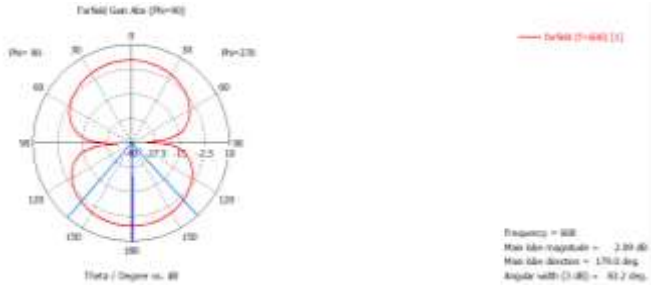

Figure 7. Radiation Patterns of Microstrip Antenna

After the antenna is designed according to the required parameters and the rectifier has been assembled according to the simulated scheme on eagle software, so the antenna can be used. The experiment in this paper requires two SOMR for Television that are in parallel. The result of SOMR measurement according to the following table:

Table 1. Result of The Measurement

Switch	Single SOMR		2 SOMR	
	Voltage (mV)	Current (mA)	Voltage (mV)	Current (mA)
OFF	17.2	0.172	36.4	0.182
ON	0	0	0	0

4. Conclusion

The SOMR switch is automatically. If the SOMR at OFF state, the voltage result is 17.2 mv and the current measured 0.172 whereas two Switch Operation Mode Rectenna (SOMR) are paralleled the voltage obtained is 36.4 mv and the current measured 0.182. When Switch Operation Mode Rectenna (SOMR) is set to be ON, both single or paralleled Switch Operation Mode Rectenna (SOMR) is measured to be zero because there is no current and voltage generated. So we can conclude that Switch Operation Mode Rectenna (SOMR) arranged in parallel produce greater current and voltage than single Switch Operation Mode Rectenna (SOMR).

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Authors

Wahju Adi Priyono, was born in Surabaya, May 18, 1960. He received Bachelor Degree from university of Brawijaya, Malang Indonesia in 1987 and Master Degree from Bandung institute of technology, Bandung Indonesia in 1995. Curently, he is working at Electrical Engineering, University of Brawijaya Malang as Lecturer.

Rudy Yuwono, was born in blitar, june15, 1971. He received Bachelot Degree from university of Brawijaya, Malang Indonesia in 1997 and Master Degree from University of Kassel, Germany in 2005 Curently, he is working at Electrical Engineering, University of Brawijaya Malang as Lecturer and Researcher. His research interest are Antena and Propagation, Microwave and Reasercher.

Eva Faliha Kusumawardhany, was born in Malang, July 23rd, 1997. She is now at Electrical Engineering university of Brawijaya, Malang Indonesia.

Raihan Tantyo P, was born in Bogor, November 30, 1997. He is now at Electrical Engineering university of Brawijaya, Malang Indonesia..Email addres: Raihantyp@gmail.com

M Fahreza Kresnamurti, was born in Tuban, August 28, 1997 He is now at Electrical Engineering university of Brawijaya, Malang Indonesia Email addres:rezafiel@gmail.com