Solar Based Cell Phone Signal Strength Amplifier on GSM 900 Frequency Band

Aditya Bahl, Nikhil Kumar, Nishant Pandey, Mrs. M.V. Patil

Abstract— The aim of the cell phone signal strength amplifier is to increase the range of the preexisting signal which is powered by a solar power supply. The operation of the cell phone signal amplifier is to take preexisting cell phone signal which is found everywhere but varying in range inside and outside your house or office, due to increase in number of obstructions a signal loses its strength, amplify this signal and then transmit it to an area which has low signal. This paper deals with a system which consists of an outer antenna, a signal amplifier unit and an inner antenna, with connecting cables all of the components.

Index Terms— GSM 900, Patch Panel Antenna, Signal Strength Amplifier, Solar Power Supply.

1 Introduction

A cell phone signal strength amplifier helps the cellular service providers or the user to enhance the weak cellular signal service. It operates on GSM 900 frequency band which uses 890 MHz-915MHz as uplink frequency and 935MHz-960MHz as downlink frequency. This amplifier is user friendly and eco friendly. Also, to provide power for the amplifier a solar panel is used. A solar panel is a combination of photovoltaic modules which are electrically connected.

The power generated by the photo voltaic cells is further used to charge a rechargeable battery which will power the signal amplifier during night time [2].

These are similar to the cellular transmission towers used by the service providers for transmiting, but are much smaller in size and are preferred to be used for a specific building only. Modern cellular amplifiers rebroadcast cellular signals inside the building. This system consists of an outer antenna which collects the available cell phone signal, which is then broadcasted to the amplification unit which amplifies the signal, and rebroadcasted it locally, providing significantly improved signal strength. An indoor environment is usually not very predictable due to the presence of moving people, doors, windows, furniture. People have a particularly large influence on trasmission of waves at frequencies of mobile systems, because the human body is highly conductive [1]. The more advanced models also allow multiple cell phones to use the same amplifier at the same time, so are suitable for commercial as well as home use. Patch panel antenna will be mounted at the roof top such that it receives the maximum signal from the nearest mobile base station and the channel to channel difference should be more than 10db [4]. Amplifier should be preserved from rain and moisture in order that it can give maximum radiations to the patch panel antenna. The job of patch panel antenna is to transmit the boosted signal to other mobile stations. Inner antenna should be mounted at the low signal coverage areas. This paper covers sections on the literature survey which deals with the work done in this field, system overview which gives a brief idea about the system layout, simulations persents the observations done, and future scope of the topic which presents further modifications which can be done to improve the system.

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2 Literature Overview

Various techniques have been developed to amplify the strength of mobile signal on various frequency bands like GSM 900, GSM 1800, 3G few of them are listed below

S. Shri Shankari et al. [2] introduced a signal booster circuit to enable the remote areas to obtain the cellular signals. Depending on many factors, such as distance from a tower, obstructions in between such as buildings etc., the signal strength will vary. Femto Cells were recommended which act like a miniaturized cell tower in your home, creating an access point for both voice and data that provides better reception than what you might be getting from the nearby cellular tower.

Kotaprolu Nanda Kishore et al [3]. described a dual band Cellular signal repeater which consists of bidirectional amplifier, receiving and transmitting antennas. They discussed about the assembling process, beginning with component selection and the issues faced in obtaining the required gain according to the user requirement in the process of testing. The idea proposed by them was particularly for 3 different operating frequency bands namely, GSM 900, GSM 1800 and 3G.

Divvela.Santhosh Raghava Rao and Sreevardhan cheerla [4] further tested Uplink and downlink frequency Response for GSM 900, GSM 1800 and 3G on a network analyzer. They observed the frequency response when booster was ON and OFF.

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3 SYSTEM OVERVIEW

The system overview covers the basic requirements for solar based cell phone signal strength amplifier with its block diagram shown in Fig 1. which is broadly divided into three parts: receiver antenna, signal amplifier, and a transmitter antenna.

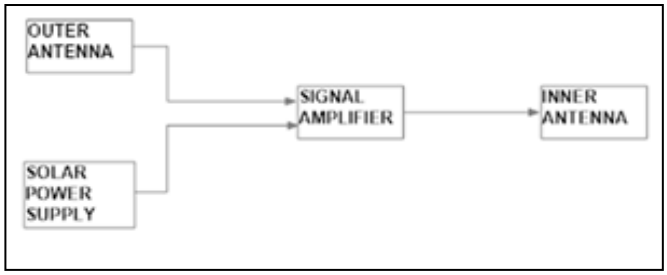

Fig. 1. Basic Block Diagram

3.1 Outer receiver antenna and Inner transmitter antenna (Patch Panel Antenna)

The outer antenna Fig. 2. is important for providing gain in signal strength. The ideal antenna for this application are directional antenna. As this antenna is located outside and aligned with the nearest cellphone tower. Patch antenna being a monopole antenna distributes the signals equally in all directions. They are omni directional in nature and have equal gain in all directions [4][5][8].

Fig. 2. Patch Antenna

3.2 Signal Amplifier

A typical amplifier layout is shown in Fig. 3. which consists of Low noise amplifier, power amplifier, mixer, band pass filters. The input signals are fetched by patch antenna and fed to low noise amplifier which is used to amplify low power signals without significantly degrading it signal to noise ratio. Further the signal is sent to band pass filter which is used to select a particular bandwidth which needs to be amplified and attenuate other frequencies. The bandwidth selected here is according to GSM 900 standards.

The output of band pass filter is given to power amplifier which is used to amplify the signal in the required bandwidth. Then a duplex filter is used to separate the low frequencies from the high frequencies [4].

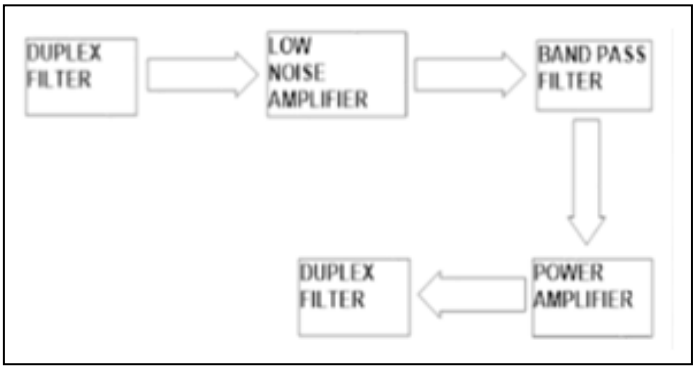

Fig. 3. Block Diagram of Signal Amplifier

3.3 Solar Power Supply

To supply the power for cell phone signal amplifier a solar panel is used. A solar panel consists of a group of photovoltaic modules which are electrically connected. Here, we are using solar cells which are used to convert the photo voltaic energy of sunlight into electricity [7]. The power generated by the photo voltaic cells is further used to charge a rechargeable battery which will power the signal amplifier during night time. The charging current can be calculated by dividng solar panel wattage with solar panel voltage.

Charging current = Solar panel wattage ÷ Solar Panel Voltage

While the time required for charging the battery can be calculated by dividing battery's Ah rating with charging current.

Charging time required = Ah rating of battery ÷ charging current

The solar power supply consists of solar panel as shown in fig 4 which receives the solar energy from sun. It converts sun's rays in electric energy. It excites electrons in silicon cells using photons of light from sun. the panels are connected to a charge controller which is a voltage and current regulator which would prevent the batteries from overcharging. This controller is then connected to a rechargeable battery of 12volts. As our amplifier requires 9volts as input voltage so we would also be connecting a voltage regulator. This voltage regulator would maintain a constant output 9-volt level.

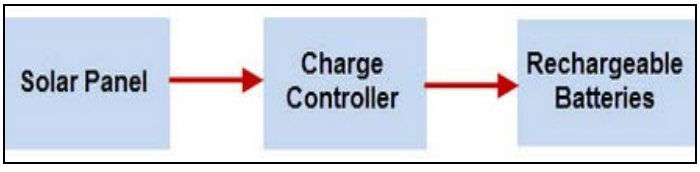

Fig. 4. Block diagram for power supply

Here we have used a 15-watt/ 18volts solar panel which is shown if fig. 5. A rechargeable battery of 12 volts 1.2 Ah.

Fig. 5. A 15-watt Solar panel

4 Simulations and Discussions

The screenshots mentioned below depict the power ratio (dBm) response for GSM 900 frequency band when the amplifier is ON and OFF. The tables 1 & 2 depict the upload speed, download speed, and latency.

4.1 When the amplifier is OFF

Download speed (Kbps)	Upload speed (Kbps)	Latency (ms)
117	26	502
98	14	724
72	9	561

Table 1. Download Speed, Upload Speed, Latency are observed when amplifier is OFF

The power ratio in dBm can be seen in fig 6. The power ratio was ranging between -75dBm to -95 dBm. This was observed when amplifier was turned OFF.

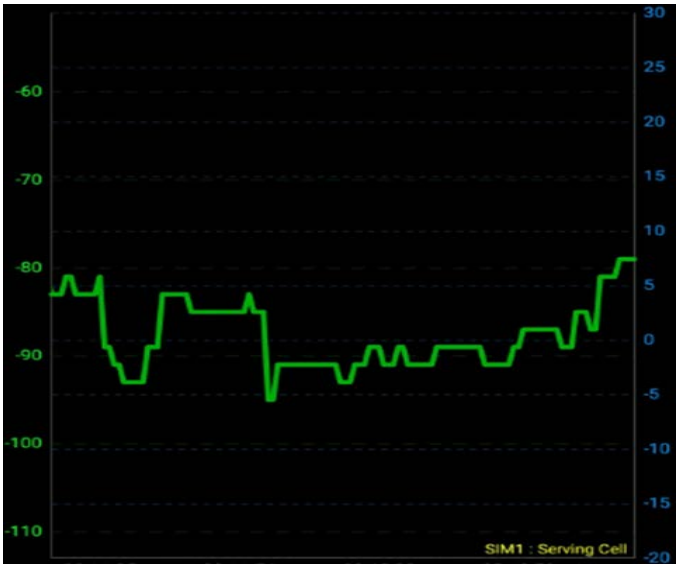

Fig. 6. Power ratio in dBm when amplifier is OFF

4.2 When the amplifier is ON

Download speed (Kbps)	Upload speed (Kbps)	Latency (ms)
189	28	391
231	31	327
197	22	341

Table 2. Download Speed, Upload Speed, Latency are observed when amplifier is ON

The power ratio in dBm can be seen in fig. 7. The power ratio was ranging between -51dBm to -70dBm. This was observed when amplifier was turned ON. Here we can observe an amplification

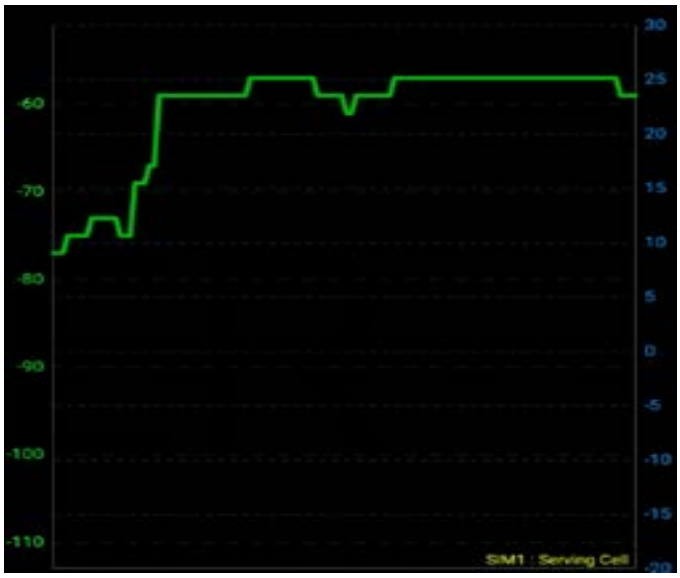

Fig. 7. Power ratio in dBm when amplifier is ON

5 Conclusion

We observed that the cellular signal strength can be improved in low cellular signal coverage areas with the help of these amplifiers. With the use of solar energy as power supply for the amplifier they can be used in areas which face long hours of power cuts. We observed the download and upload speed when the signal amplifier is ON and OFF. Hence, the need of solar signal amplifiers can be seen. Finally, we conclude by saying that communication is a necessity these days but lack of cellular signals makes it difficult. This shortcoming is overcome by cellular signal amplifiers.

Future modifications or recommendations which can be done in order to make this system better are:

a) Car Antenna

Till now we discussed about a system which is for a closed area. But we can face the same problem in our moving vehicles because cars prevent mobile phones from receiving the cellular signals. Due to this poor voice quality and call drops are experienced.

b) Other frequency bands

With more frequency bands being made available for communication. This system can be used for 3G, 4G as well.

ACKNOWLEDGMENT

The authors wish to thank Mrs. M.V. Patil (Assistant Professor), Department of Electronics, BVUCOE, for her valuable support in guiding us.

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