Proc. Annual Symposium on Research & Industrial Training, 02(2015) 85-90
Department of Electronics – Wayamba University of Sri Lanka

DESIGNING A LOW COST REPEATER FOR GSM 900 BAND

R.P.A.Upeaksha*, K.P. Vidanapathirana

Department of Electronics, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka

*rpaupeaksha@gmail.com**

ABSTRACT

Most of the times customer complaints in mobile telecommunication system are filled with low signal coverage. When providing a solution to customers who are not having stable network connection, it is possible to use a repeater solution for underground buildings, a building fully covered with other buildings from outside, geographically un-visible areas and far places from RF range. To have good coverage level inside or outside it is needed to amplify the signal levels and serve customers by amplified signal. To solve these kinds of issues in mobile networks it is need to place a suitable equipment at the customer's location. An equipment is used to amplify the signal level into suitable percentage. The device which is used to do the amplification is called a repeater. But the existing systems are very expensive and they amplify another subscribers frequency bands as well. In this study, it was decided to provide a solution to this problem is reported. For that, ADL5545 was used as preamplifier, HMC476MP86E used as a power amplifier, Band pass filter was used to filter the required GSM 900 frequency band. It has a filter called as B67900M1which is having high accuracy. Transmitting and receiving antennas were used as a purpose of transmitting and receiving of GSM 900 Band. System has total gain of 50dB and having the 50dB uplink gain and 50dB downlink gain. The uplink is amplified and filtered for the GSM 900 (885MHz to 892.5 MHz) frequency band and the downlink is amplified and filtered for the GSM900 (930MHz-937.5MHz) frequency band.

Keywords: Customer Complaint, Pre amplifier, Power amplifier

1. INTRODUCTION

Repeaters are available in telecommunication market nowadays. These repeaters are universal and make huge costs for installation and maintenance[1]. The service provider is using 900MHz, 1800MHz for 2G (GSM) and 2100MHz for 3G services. Basically the repeaters which are available at the telecommunication market are having the facility to

function on 2G (900 & 1800) and 3G (2100). These are functionally well but are very costly. When a customer only requires 3G or 2G, it cannot be selected from repeater because it's coming with dual band supported. In the present method, low cost repeater solution is provided for low signal coverage.This proposed system includes a solution for the band selection while solving coverage problem. Also it has the ability to filter the GSM900 frequency band and then do the amplification.

2. EXPERIMENTAL

The block diagram of low cost repeater system is shown in figure 1.

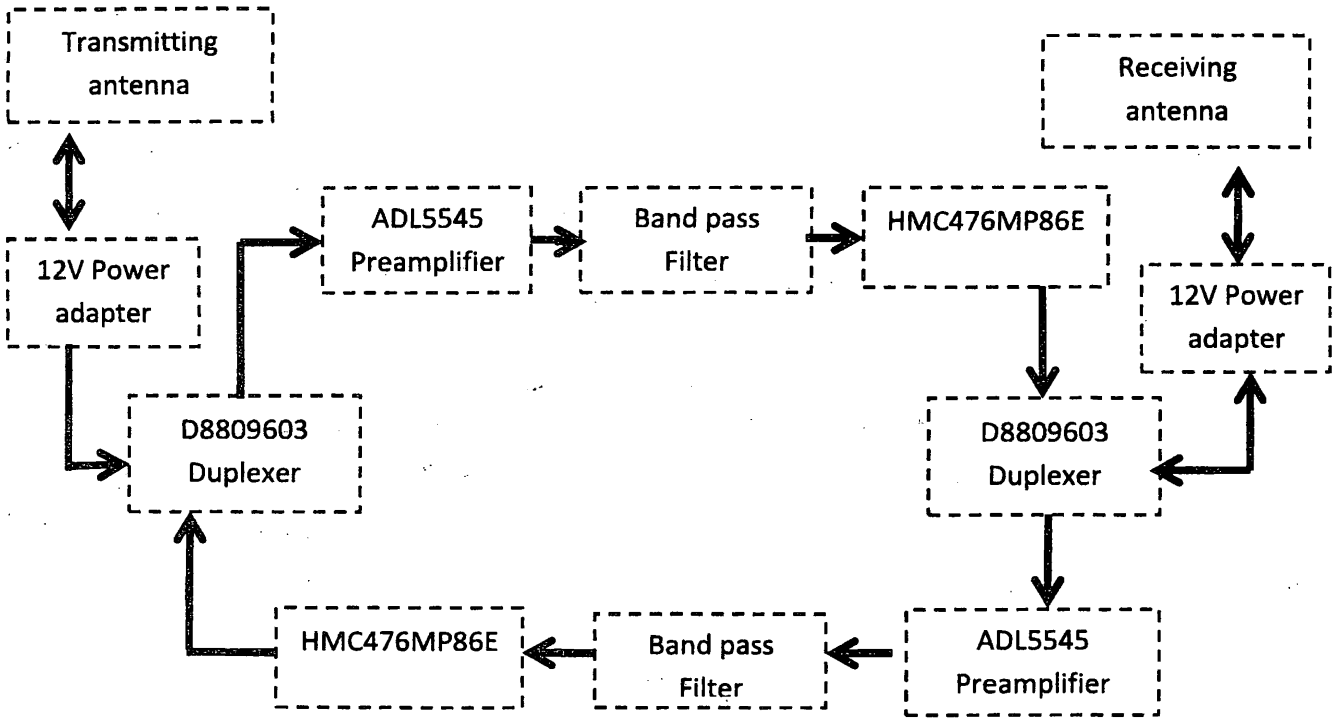

Figure 1: Block Diagram of Low cost repeater

The input/output connector of the repeater is SMA Female type and a communication method is Duplex Communication. The power supply is AC-DC (+5 V) external power supply adapter. In the forward path (Base Station Controller towards (BTS) User Equipment (UE)) of system, a signal from the BTS is received through the donor antenna and the received signal is isolated from the transmitter by a duplexer. This isolated signal is first go through a low noise amplifier and then it is amplified at the second stage prior to final stage power amplification the signal is filtered by a band-pass filter[2]. The output signal from the final

amplifier is transmitted through the duplexer towards the service antenna. A directional coupler monitors the output power level of the transmitting signal to serving antennas. The circuit of the reverse path is the same as that of the forward path. The signal from the mobile handset is received by the service antenna of the repeater and transmitted through the donor antenna. PCB design is shown in figure 2, 3 for uplink and downlink.

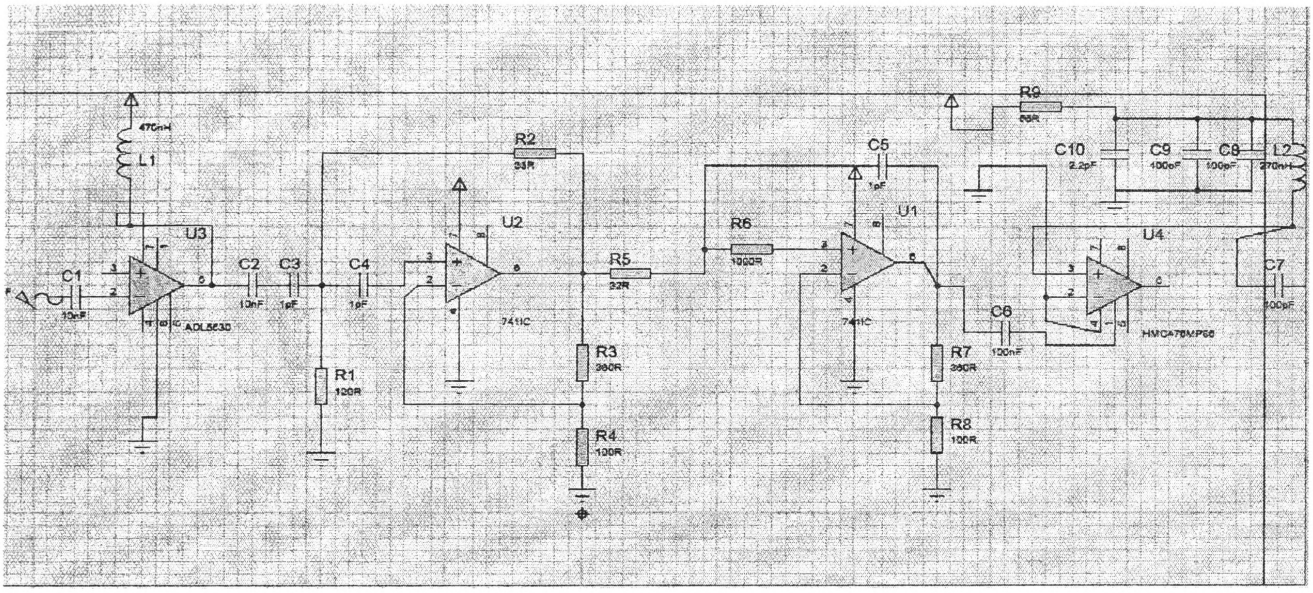

Figure 2: Circuit diagram for uplink (885MHz-892.5MHz) of GSM 900 repeater

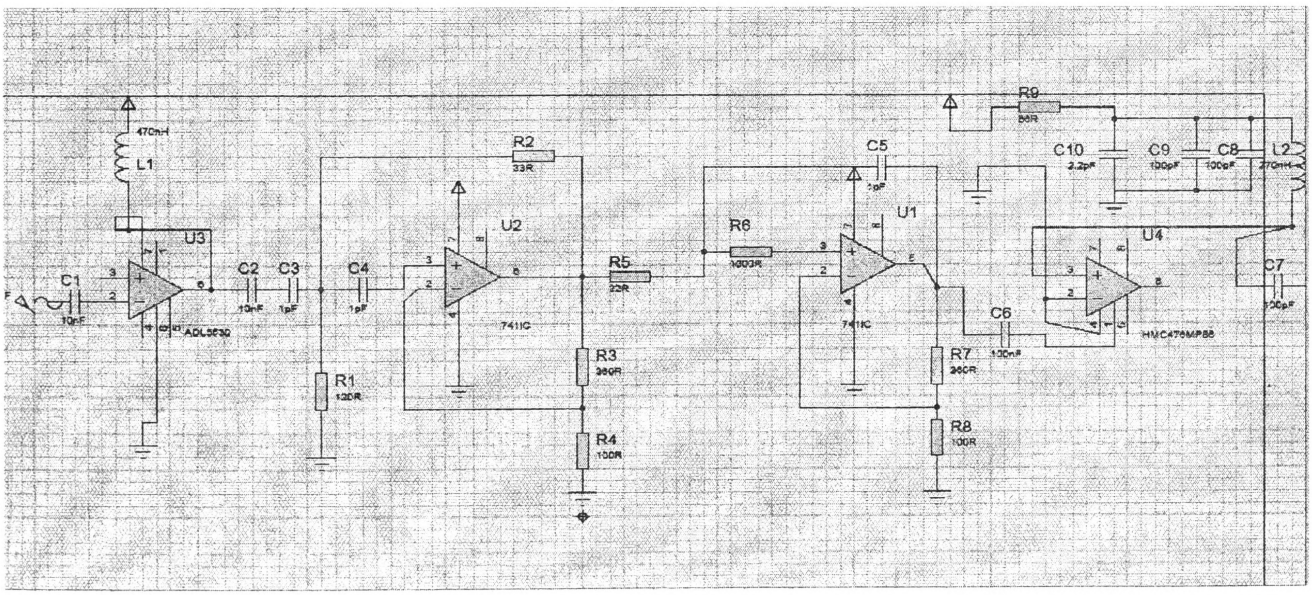

Figure 3: Circuit diagram for downlink (930MHz-937.5MHz) of GSM 900 repeater

3. RESULTS AND DISCUSSION

Output of the Low cost GSM 900 Repeater is shown in table 1.

Table 1: Total output details of Low cost repeater system.

System	
Total Gain	50dB max
Operating Voltage	5V to 9V (AC-DC)
Pass band ripple	
Noise Figure	< 7dB to 10dB
Characteristic Impedance	50 ohm
Uplink	
Gain	50dB Max
Operating Frequency	885MHz to 892.5MHz
Input power range	< -45dBm
Maximum Output Power	5dBm Max
Downlink	
Gain	50dB Max
Operating Frequency	930MHz to 937.5MHz
Input power range	< -85dBm Min
Maximum Output Power	0dBm Max

Gain of the amplifiers and noise figure of preamplifier and power amplifier can be represented by equation 01, 02.

$$\text{Gain (dB)} = 10 \log \left(\frac{\text{Output signal power}}{\text{Input signal power}} \right) \longrightarrow \quad \textbf{(01)}$$

$$\text{Noise Figure (NF)} = \frac{\text{Signal to Noise ratio of input signal } (SNR_{in})}{\text{Signal to Noise ratio of output signal } (SNR_{out})} \longrightarrow (2)$$

This repeater system has two antennas, one for receiving purpose and other for transmitting purposes. Transmitting antenna is placed in a place that has a good coverage. It means, most of the time this type of problems is occurred inside of a building but outside of building is having good coverage area. Receiving level of signal at outside of building may be larger than -70 dBm. This is the best place to place the transmitting antenna. The antenna receives the GSM 900 band signal (885MHz-992.5 MHz) and this signal is amplified through the two amplifiers called as preamplifier and power amplifier.[3] Preamplifier is used to increase the strength of the signal to drive the cable to main instrument without decreasing the signal-to-noise ratio (SNR). Power amplifier is used to convert a low-power radio –frequency signal into large signal of significant power.

This type of signal goes through band pass filter. Band pass filter was used to filter the GSM 900 uplink and downlink frequency bands. Band pass filter allow 10MHz bandwidth on 885MHz to 892.5MHz range and its Operation voltage 5V to 12V[2]. This amplified and filtered signal is sent to the receiving antenna. Receiving antenna is getting good receiving levels. It means, receiving antenna is having the ability to spread out signals with high strength where by subscriber can receive signals of same strength. This signaling process will be applied to both uplink and downlink. System results a total gain of 50dB.

4. CONCLUSION

The low cost GSM 900 repeater was designed to solve the low voice signal coverage problem and quality problem. In this design, only uplink was included because it was difficult to find the power amplifier and pre amplifiers. This system improves the receiving level of signals that is limited to one type of frequency range. This can be developed to include GSM 1800 and 3G bands using required filters, preamplifiers and power amplifiers.

ACKNOWLEDGEMENTS

Authors would like to express their gratitude to all at Wayamba University who have helped for the successful completion of the system. Also support provided by Mr.Sumith Fernando

who is the external supervisor of Manager Radio Network Optimization of Mobitel (pvt) Ltd is highly acknowledged for his guidance and supervision.

REFERENCES

[1]. http://www.criterioncellular.com/tutorials/repeaters/repeaterissues.html

[2]. http://www.electronics-tutorials.ws/filter/filter_4.html

[3]. http://www.slideshare.net/zunaibali/instrumentational-amplifier