ANALYSIS AND DEVELOPMENT OF A LOW COST GSM TELEPHONE SYSTEM FOR A RURAL AREA

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Abstract: This work presents the analysis and development of a low cost GSM telephone system. A review of radio receiver and transmitter architectures showed the superheterodyne as having a better performance overall the direct conversion radio in terms of selectivity and complexity. A low power bidirectional transceiver was developed based on the superheterodyne architecture. The specifications of the bidirectional transceiver were computed using specifications of the component modules in the spreadsheet approach. The resulting design was optimized using Matlab programs and simulated using the Genesys simulation software. The results show the front end of the transceiver as the most critical part of the transceiver. Both the generic and proposed transceivers had frequency response from 1700MHz to 1900MHz, the same dynamic range and noise figure but the proposed transceiver achieved these results with a 50% reduction in power amplifier and low noise amplifier chips and the 75% reduction in the number of voltage oscillator chips. This reduction in component count led to a 40.59% reduction in power requirement and a reduction in the overall cost of the proposed transceiver. The reduced power consumption of the architecture enables the use of solar energy as an alternative source of power supply for the transceivers.

1.0 Introduction

The super heterodyne architecture in spite of its requirement of off chip filters and the image frequency problems was found to be the best architecture for the design of low cost transceiver systems [1,2,3,4,5,6,7,8,9,10,11]. A review of the current approaches at low cost GSM infrastructure shows that the main focus of research at developing low cost systems has been targeted at the development of soft switches for mobile switching centers and the development of higher capacity and more efficient back up/alternative power supply systems [12,13]. This work however focused on the reduction in power consumed by the base transceiver station (BTS). The motivation for this work is the fact that the BTS far out number the other component systems of the GSM network and as such has the greatest impact on the cost of GSM operations. [14, 15]

1.1 Parameters For Characterizing The Transceiver

The parameters of the transceiver and the main formulas are discussed in this section.

1.1.1 Noise figure:

The noise figure is a parameter that determines how much noise the component adds to the signal as the signal passes through it. [16,17]

The noise figure for cascaded systems is derived from equation 1 which is the Friis equation for noise figure in cascaded systems [16].

\[ F_n = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1G_2} + \ldots + \frac{F_n - 1}{G_1G_2\ldots G_{n-1}} \]

substituting the values for the noise factor of the different blocks in Table-1 into the equation 1 yields the cascaded noise factor. Noise Figure = 10 log (F).