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List of Symbols

AM	amplitude modulation
VLSI	very large scale integrated circuit
VLIF	very low intermediate frequency
WLANs	wireless local area networks
RF	radio frequency
GSM	globle system for mobile
GPRS	globle position receiver system
EDGE	enhanced data globle system for mobile
IS-95	information sevices
UMTS	universal mobile telecommunication system
IMT2000	international mobile telecommunication
DECT	digital enhanced cordless telecommunication
III-V	compound semiconductor
HMIC	
MMICs	
A/D	
LNA	
VGA	
CAD	
PCs	
SAW	
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IP_{1dB}	
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Abstract

The ever - increasing demand for radio spectrum in the fast growing area of wireless communication system is driving RF design into higher microwave frequency bands.

The main aim of this thesis is to present design, implement and measure a transceiver RF- front end for ISM-Band wireless communications. The transmitting and receiving parts are isolated by T/R switches. A band pass filter is placed before the low noise amplifier (LNA). A high linearity class –A power amplifier is driven by a preamplifier. A single –ended resistive FET mixer is designed for both up- conversion and down conversion. The design goals are to emphasize low noise figure at first stage, have high gain at the second stage and the conjugate matching is designed between the two stages. Three T/R switches are used, in the RF front – end module to switch between transmitting and receiving modes. Two RF band-pass filters are used the first is between the antenna switch and LNA and the second lies before the mixeras.

A suitable software packages, advanced design system (ADS), Zeland IE3D, Aplac, were used to simulate the performances of the designed separate circuits, by applying the appropriate type of simulation for each circuit. Then we fabricate these circuits and measure its performance.

Circuits included in this transceiver (antenna, band –pass filter, low noise amplifier, power amplifier, power driver, T/R switch, mixer) are designed by the aid of synthesis formula corresponding to each.

In addition to this, suggesting two novel microstrip antenna configurations with very small size and wide bandwidth suitable for mobile communication. These antennas can operate on multimode operation. If switch is carried out for the vias, the operating frequency range can be extended up to 8GHz. Suggesting three novel microstrip RF filters with good performance and very small size as compared to the conventional ones. Building a calibration kit using FR-4 dielectric substrate (cheap and lossy) suitable to operate in the frequency range 0.4 GHz up to 3.5 GHz. Analyzing, designing , fabricating and measureing a power amplifier with its driver, low noise amplifier on the IC level, which causes reduction in size using distributed and lumped techniques.

The required front end of the transceiver was implemented using hybrid integrated circuits, in which the passive components were realized

using thin film technology and photolithographic technique, while the active elements were mounted on the dielectric substrate.

The ADS software package is then used to simulate the performances of the designed separate circuits of the transceiver, by applying the appropriate type of simulation for each circuit. If the given specifications are not satisfied, then one of the optimization techniques, available in this package, is used to reach the optimum response desired. These circuits are connected to each other in two different paths (tramsmitter and receiver) to represent the transceiver. The performance of the two paths are simulated and optimized to meet the required specifications.

Finally, the circuits constituting the transceiver (antenna, LNA, RF-band pass filter, power amplifier and its driver, T/R switch, IF mixer, IF- filters are fabricated individually except T/R switch, mixer, IF filter due to components limitation. The fabricated circuits were measured using the vector network analyzer ES-8719 in the microstrip department (electronic research institute).

Chapter 1

The ever - increasing demand for radio spectrum in the fast growing area of wireless communication system is driving RF design into higher microwave frequency bands.

The main aim of this thesis is to present design, implement and measure a transceiver RF- front end for ISM-Band wireless communications. The transmitting and receiving parts are isolated by T/R switches. A band pass filter is placed before the low noise amplifier (LNA). A high linearity class –A power amplifier is driven by a preamplifier. A single –ended resistive FET mixer is designed for both up- conversion and down conversion. The design goals are to emphasize low noise figure at first stage, have high gain at the second stage and the conjugate matching is designed between the two stages. Three T/R switches are used, in the RF front – end module to switch between transmitting and receiving modes. Two RF band-pass filters are used the first is between the antenna switch and LNA and the second lies before the mixers as shown in Fig.1.1.

A suitable software packages, advanced design system (ADS), Zeland IE3D, Aplac, were used to simulate the performances of the designed separate circuits, by applying the appropriate type of simulation for each circuit. Then we fabricate these circuits and measure its performance.

Circuits included in this transceiver (antenna, band –pass filter, low noise amplifier, power amplifier, power driver, T/R switch, mixer) are designed by the aid of synthesis formula corresponding to each.

In addition to this, suggesting two novel microstrip antenna configurations with very small size and wide bandwidth suitable for mobile communication. These antennas can operate on multimode operation. If switch is carried out for the vias, the operating frequency range can be extended up to 8GHz. Suggesting three novel microstrip RF filters with good performance and very small size as compared to the conventional ones. Building a calibration kit using FR-4 dielectric substrate (cheap and lossy) suitable to operate in the frequency range 0.4 GHz up to 3.5 GHz. Analyzing, designing , fabricating and measureing a power amplifier with its driver, low noise amplifier on the IC level, which causes reduction in size using distributed and lumped techniques.