RFIC Solutions

Case Study of

Design of Ultra Wideband Radio

Table of Content

RFIC Solutions Inc.

RFIC Solutions Inc is a fabless RF Design House focused primarily on wireless Solutions, with Headquarters in SanJose, USA and design center in India. We design highly integrated system on chip (SOC) and system on a package (SOP); custom ICs, IP cores using state-of-art GaAs, InGaP/GaAs, InP, CMOS and SiGe Semiconductor processes utilizing MESFET, pHEMT and HBT devices. Expertise includes LNA, PA, Switch, complete transceivers/RFICs & RF Modules for any wireless system including WLAN, WiMax, PCS and Cellular applications.

RFIC Solutions Inc. is a Total solution provider for RF & Microwave. Our Business model encompasses Design IPs, Design services, PCB Design services, Layout services, Foundry services & Supply of complete RF chips.

The Client:

The client was working on development of Wireless systems based on Ultra Wide Band Communication standards. They have experience in developing Wired and Wireless solutions with expertise in providing Wireless Mesh Network solutions. The client had expertise in Digital design with very little knowledge about RF and Analog Base-band. They were looking for a partner who can provide a RF and Analog Front-end for the Digital Base-band.

Design Challenges:

A Board level solution was desired that could be used as a Proof-of-Concept for the new technology being developed. The major design challenges are listed as below:

a. Low cost and Low power architecture was desired. However the choice of the architecture was limited by the availability of off-the shelf components.
b. RFIC was required to support the frequency input from 3 to 8.4 GHz. It was difficult to find a single chip solution for RF or even building blocks that can support this broad range of frequency. Military grade solutions were available but we needed something that meets the low cost requirements for the targeted commercial applications where the solution will be used.
c. FCC limits the power that can be transmitted over UWB system, utilizing 500 MHz bandwidth to be less than -14dBm. This made the sensitivity requirements for the receiver to be less than -105 dBm to obtain a respectable SNR.
d. In the transmitter analog Base-band design, a suitable circuit was to be designed to generate a 2 nsec pulse from a 250 MHz input clock signal.

Our Solution:

Team at RFIC Solutions was responsible for design, testing and interfacing of the RF and Analog Base-band radio with the Digital Base-band board developed by the client. The approach and solution provided by us is discussed as below:

a. A detailed study of three architectures; Super Heterodyne, Direct Conversion (Zero IF) and Low IF architecture was done. The availability of commercially available components was the basis of comparison of these architectures. First hand system level simulations were done for each of these architectures with electrical parameters of the available off-the shelf components. Agilent's ADS tool was used for this. Based on the simulation results a super heterodyne architecture was found to be most suitable for the proposed system.
b. RFIC Solutions team used its expertise in RFIC design to select the best available off-the shelf devices and also ensured that the devices are procured on time.
c. A distinguishing feature of the proposed solution was the development of the 2 nsec pulse generation circuitry. Design Team at RFIC Solutions, developed a low power and robust circuit for 2 nsec pulse generation based on use of Delay lines and NAND gates.
d. We did the schematic entry, BOM generation, Net-list generation using OrCAD Capture CIS tool.
e. The Layout was done using OrCAD Layout Editor Tool. The Board stack-up was designed to ensure a good isolation between various layers and RF parts.
f. A very clean Power Supply was provided to ensure low noise performance.
g. EM simulation was performed for the complete board to ensure minimal effect of Board parasitic on the System level performance.
h. RFIC Solutions team used Vector Network Analyzers, Spectrum Analyzers and Digital Oscilloscopes (up to 50 Gsps sampling rate) for testing and trouble-shooting of the system.
i. Finally we helped the client in interfacing the RF and Analog base-band board with the Digital board. We worked with the signal integrity team of the client and helped them to develop suitable interface for the Digital Clock signal (for transmitter) and 250 MHz Analog output (for the receiver ADC).

Benefits for client:

Our expertise in RF Analog system & IC level design provided our client with numerous benefits. Some of the most significant contributions of our team are discussed below.

a. We proposed a Super Heterodyne architecture which was thought to be high power and high cost. This architecture was proposed based on the availability of off-the shelf ICs. However selection of this architecture led to considerable savings of DC power consumption of the Digital Baseband Board by eliminating the need for IQ mismatch calibration algorithms in Digital Baseband design. This also led to considerable savings on engineering cost at the client's end.
b. We solved the problem of generation of 2 nsec pulse using the 250 MHz clock available from digital baseband board. The client had earlier failed in its attempt to generate such pulse.
c. Our experience and relationship with IC vendors made it possible to get the components on time and hence avoided unnecessary delays in the project, due to long IC lead times.
d. With the effort of our team the client was able to demonstrate a Proof-Of-Concept for the UWB based communication system.