S M Technologies

Designing The Wireless World

Case Study of Cable Modem Termination System (CMTS) Up converter System level design, Testing and Troubleshooting

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SM Technologies Pvt Ltd.

SM Technologies Pvt. Ltd. is an Indian company and the sister concern of RFIC Solutions Inc., headquartered in USA. As a fabless RF design house, SM Technologies focuses on advanced wireless solutions, with its design and development activities carried out in India. The company specializes in highly integrated System-on-Chip (SoC) and System-in-Package (SiP) solutions, custom ICs, and IP cores using state-of-the-art GaAs, InGaP/GaAs, InP, CMOS, and SiGe semiconductor processes, utilizing MESFET, pHEMT, and HBT technologies. Its expertise includes the design and development of Low Noise Amplifiers (LNAs), Power Amplifiers (PAs), RF Switches, complete transceivers, millimeter-wave chips, and RF modules for a wide range of wireless applications, including WLAN, WiMAX, PCS, and cellular systems

The Client:

The client was a US based organization, one of the big supplier of networking equipment and network management for the Internet headquartered in San Jose, California. It designs and sells networking and communications technology and services. Products includes Routers, switches, network management, interfaces and modules, optical networking, wireless systems, RF and mixed signal board designs.

Design Challenges:

The Client had an existing Up converter board which was part of CMTS (Cable Modem termination System) that had design and specification compliance issues. They wanted new solutions to the existing design that will help the Up converter board to comply with DRFI (Downstream RF Interface Specifications) specs on noise floor and spur specifications.

SM Technologies was chosen to help in finding solutions on various issues in the board within 6 months. It was a mixed signal & RF design board, operating from 54 MHz to 870 MHz RFIC was asked to deliver on following objectives.

1. SM Technologies will review the current schematic and board.
2. Based on the current issues related to board, SM Technologies will propose different versions of board by modifying the existing board.
3. SM Technologies will replace some Chips currently used on the board with alternative chips to optimize the performance (like spur rejection).
4. SM Technologies will do the testing of the board.
5. SM Technologies will deliver modified board versions based on test results of revised boards.

Issues with the Board:

1. Current Test results showed noncompliance to DRFI specs (Downstream RF Interface Specifications).
2. The 2nd and 3rd Harmonic were too high and were missing the specifications on spurious.
3. Noise floor was too high.
4. Oscillations at 2.3 GHz create many difficulties in meeting DRFI specification.
5. The passive components were taking too much space on board, which increased the size of board and increased parasitic.

Our Solution:

The client chose SM Technologies because of our innovative design service model whereby we utilize some of our existing Design IPs, Reference designs/boards and project execution process. We presented a project plan which was efficient in time & engineering resources. SM Technologies has innovative and cost-effective pricing model that addressed the defined design requirements of our client. The low cost design service was possible through SM Technologies India design center, where a team of dedicated engineers is providing high quality RFIC design solutions to our customers.

SM Technologies performed a critical design review of the existing system/board. RFIC solved all the layout related issues like grounding, power supply, long traces, coupling, usage of IC's in power up/power down mode, shielding etc. in first phase. SM Technologies provided feedback on improving the specification. Based on technical reviews and recommendations we proposed different board versions for testing.

SM Technologies provided full support to the team of engineers working at client side during fabrication, testing and troubleshooting of modified board designs. Our RF specialist design team delivered high performance boards with flexibility to test and troubleshoot the boards.

SM Technologies Key Contributions:

SM Technologies Pvt ltd studied and recommended changes in existing board to achieve DRFI compliant specifications for noise floor and spur. Here is the summary of key recommendations and solutions by SM Technologies, that helped improve the results:

1. Test Results showed that SM Technologies modified board version had improved noise floor and spur specs. SM Technologies played a major role in testing and troubleshooting of this board. Earlier, the noise floor and spur were off by ~15dB and after modifying the design and

Trouble shooting SM Technologies modified board, results were very close within 3dB to the DRFI specs. Our measured results showed 2-5 dB better performance than the current client boards in terms of noise floor and spurs.

2. SM Technologies team made some major contribution by providing recommendation to replace the first stage VGA chip by LNA. SM Technologies did the VGA simulation and found that VGA has a tendency to oscillate around frequency of 2.7 GHz. We replaced the VGA in our modified board version with LNA and that made it more stable, but the second stage VGA still had a tendency to oscillate. Very careful matching had to be done to make this 2nd stage VGA stable under all conditions.
3. SM Technologies also recommended to change the supply voltage of Clock buffer/ Driver to improve the noise floor and spurious performance. We increased the supply voltage for the clock buffer IC, upon which the test results showed improved noise floor.
4. Our improved Design grounding, symmetry of the layout and addition of filters also helped reducing harmonics, and spurious performance.

Benefits for client:

SM Technologies was able to provide on time, cost efficient service to our client which helped them modify the board designs to much better performance within 8 months, from the start of project. The client achieved:

- Required specification with small modifications in design and board.
- Same board size so client was able to replace it in existing systems without redesigning the complete system setup.
- Efficient & focused usage of engineering resources at their location.
- Higher satisfaction through our continual service improvement and support.