



**Case Study of
Design of High-Performance
Low Noise Amplifiers MMICs**

Table of Content

Table of Content	1
RFIC Solutions Inc.	2
The client	3
Design challenges	4
Our solution	5
Benefits for client	6

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 a South Korea based organization that designs innovative solutions, and is dedicated to RF technology and products for wireless industry. They provide next generation products and are manufacturer of innovative RF components including gain blocks, local drivers, IF ICs, power amplifiers, discrete devices, and RF integrated circuits (RFICs).

Design Challenges:

The client wanted to move towards leadership position in the market by focusing on business and revenue growth through Low Noise, high linearity RFIC amplifier designs. The client was looking for a low noise amplifier design with low noise and good linearity. They wanted high-performance design solutions on their cellular, PCS and WCDMA band LNA design. Quick and cost-efficient solution was highest priority. Client also wanted a single chip solution which can be tuned for performance in terms of NF, Gain, OIP3 in the above-mentioned bands, which means a high performing broadband LNA chip.

RFIC Solutions was chosen to design all 4 LNAs on GaAs process with highly stable performance for low noise and linearity over temperature, process and supply voltage variations within 6 months which included the IC fabrication and testing time. The designs were covering 40MHz to 4GHz frequency band.

Our Solution:

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

RFIC Solutions Inc. completed 4 LNA designs within the specified time and met all the specification over process, temperature & supply voltage variations, in the ready for tape out design. RFIC Solutions used proven design techniques to provide stable performance over temperature and supply voltage variations. The designs required only coupling and bypass capacitors as off-chip components reducing the cost of board assembly.

RFIC Solutions provided full support to the team of engineers working at client side during GDSII tape out of the designs. Our specialized RFIC layout design team provided high-performance layouts with ability to tune the circuit with minimum mask changes or through a concept called “mask sharing”. Client was able to send all designs for fabrication on scheduled time. RFIC Solutions also helped client in testing of designs with test plans, component data, and assembly diagrams as a part of our overall design service flow.

Team of engineers from our design center constantly communicated with the client for any specification changes till the GDSII tape out. Our interactive approach immensely satisfied our customer as they were able to include any design changes to their satisfaction. We made sure that the design changes were tracked and done extremely efficiently because of the use of innovative and robust design approaches and project management strategies.

The designs were assembled and tested after fabrication and all designs showed compliance with the simulated specifications with OIP3 as high as 38dBm and noise figure as low as 0.65dB. The broadband LNA showed deviations from desired specifications by 3-5dB and required some tuning to achieve close to desired performance over the 40MHz to 4GHz band.

Benefits for client:

RFIC Solutions Inc. was able to provide within the design window, a cost-efficient service to our client which helped them introduce new high-performance LNA Chips in market within 7 months from the start of project. The client achieved:

- 0.5 to 1dB of better Noise Figure performance over the other competition.
- High linearity performance over the other competition.
- Cost reduction of 40% due to RFIC solutions cost -effective design service.
- Efficient & focused usage of client's own engineering resources.
- Product launch within scheduled time.