Millimeter Chips

Best RF, Microwave, & Millimeter wave ICs

Case Study of Design of High-Performance Distributed Amplifier MMICs

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Millimeter Chips Pvt. Ltd

Millimeter Chips Pvt. Ltd. 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, DA Switch, complete transceivers/RFICs & RF Modules for any wireless system including WLAN, WiMAX, PCS and Cellular applications.

Millimeter Chips Pvt. Ltd. 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 Millimeter Chips.

Introduction:

A **Distributed Amplifier** is a type of broadband amplifier that utilizes multiple gain stages to amplify a signal over a wide frequency range. It is commonly used in microwave, RF (radio frequency), and optical communication systems where high gain and wide bandwidth are required**.** A distributed amplifier is based on the concept of **transmission line theory**, where multiple transistors (or gain stages) are connected in parallel along artificial transmission lines—one for the input and one for the output. These transmission lines are formed using inductors and capacitors to ensure proper impedance matching and signal propagation.

By efficiently distributing the signal across multiple transistors, a distributed amplifier enhances signal amplification while minimizing signal loss over a wide bandwidth.

Design Challenges:

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

Millimeter Chips Pvt. Ltd. was chosen to design a Distributed Amplifier on a 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 DC to 26GHz frequency band.

Designing a distributed amplifier (DA) presents several technical challenges that affect its performance, efficiency, and integration. Some of the most critical design issues include stability, off-chip component requirements, gain flatness, and layout complexity**.** To improve stability, proper termination, optimized biasing networks, and careful selection of active devices are required. To address gain flatness, careful impedance matching, optimized transmission line design, and gain equalization techniques are required.

Designing a distributed amplifier involves overcoming challenges, careful circuit design, impedance matching, and advanced simulation techniques are required to ensure a stable and efficient DA for high-frequency applications.

Our Solution:

The client chose Millimeter Chips Pvt. Ltd. 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. Millimeter Chips Pvt. Ltd. has innovative and cost-effective pricing model that addressed the defined design requirements of our client. The low-cost design service was possible through Millimeter Chips Pvt. Ltd. India design center, where a team of dedicated engineers is providing high quality Millimeter Chips Pvt. Ltd. to our customers.

Millimeter Chips Pvt. Ltd. completed Distributed Amplifier 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.

Millimeter Chips Pvt. Ltd. provided full support to the team of engineers working at client side during the GDSII tape out of the designs. Our specialized Millimeter Chips. layout design team provided high-performance layouts with the 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. Millimeter Chips Pvt. Ltd. also helped client in testing of designs with test plans, component data, and assembly diagrams as a part of our overall design service flow.

A team of engineers from our design centre 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 20.6 dBm and noise figure as low as 2.3dB. The broadband Distributed Amplifier showed deviations from desired specifications by 3-5dB and required some tuning to achieve close to desired performance over the DC to 26 GHz band

Benefits for Client:

Millimeter Chips Pvt. Ltd. was able to provide within the design window, a cost service to our client, which helped them introduce new high-performance Distributed Amplifier Chips in the market within 7 months from the start of the 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 Millimeter Chips Pvt. Ltd. cost-effective design service.
- Efficient & focused usage of the client's own engineering resources.
- Product launch within the scheduled time.