RFIC SOLUTIONS INC.
CORPORATE PRESENTATION

Dr. Sanjay Moghe,
CEO, RFIC Solutions Inc. Milpitas, CA, USA
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Phone: 415-666-2744
India Design Centre: SM Wireless Solutions Pvt. Ltd. Nagpur
Phone: +91-9922781815
RFIC Solutions at a Glance

- Established June 2005 – offering RFIC/ Analog/Mixed-Signal/Digital ASIC/Module design services and IP
- Design Center of RFIC Solutions in Nagpur, India, Staff of nearly 35 employees, B.S., M.S., Ph.D. Degrees
- Completed multiple tape-outs on different technologies like LP RFCMOS, CMOS, SiGe BiCMOS, GaAs pHEMT, GaAs MESFET, GaAs HBT.
- We have taped out at 6 different foundries & designed 150 plus different RF building blocks covering 0-70 GHz.

Services Offered
- RF, Analog & Mixed-Signal IC’s and Module design services
- RF, Analog & Mixed-Signal layout design services
- Digital ASIC & FPGA design, development services
- RF Prototype Board Design & Development
- FPGA Prototyping
- Highly Integrated Packaging, MCMs (Multi Chip Module)

Technology Expertise
- Process: RFCMOS, CMOS, BiCMOS, GaAs, SiGe, InGaP/GaAs
- Packaging: Standard packages, Modules
Management

Dr. Sanjay Moghe,
C.E.O.
RFIC Solutions Inc. USA
Email: smoghe@rficsolutions.com

- Our goal is to provide innovative design services for complex RFIC solutions and wireless modules for challenging wireless communication system at lowest possible rates in the rapidly expanding consumer broadband markets.
- The focus of the company is to offer RFIC and Module design services for wireless (WiMAX, WiFi, UWB, ZigBee etc) and high speed wired applications.
Management

Dr. Sanjay B. Moghe - CEO

Background:

- Over 30 years of experience in Wireless Industry
- Co-founder, President & CTO of RF Solutions for 2000-2003, a leader in WiFi RF chips (acquired by Anadigics in 2003)
- Startup experience with RF Solutions & Pacific Monolithics. Helped raise $17M funding. Managed engineering organization with 40+ engineers in large and small companies (Raytheon, Avantek, Northrop Grumman, ADC telecom, Micro Linear etc.). Developed 600+ RF IC products using SiGe, GaAs (MESFET, PHEMT, HBT), BiCMOS technologies.
- 6 patents granted, published 45 papers in international journals, chaired many conferences
- Education: Ph.D.EE(RPI), MSEE, MS Physics (U of Louisville), BS
- Active in 802-xx and other standards bodies, Chaired the 802.16 PHY group for unlicensed band (2000-2001)
Management

Kausik Mandal,
Director
SM Wireless Solutions
Email: kausik@rficsolutions.com

- Our business executive for strategic partners based in Singapore
- 15 years of experience in the Global Semiconductor Industry (RF, Analog, Digital). At NXP Europe he has driven a $70M RF Business Portfolio. Driven & steered RF product Introductions Globally in GaAs (pHEMT), SiGe & RF CMOS technologies.
- Worked with Silicon Hive B.V., a Start up on Reconfigurable Processors (for Digital RF, Wireless & Media applications) funded by Intel Capital, Philips.
- He was instrumental in introducing world’s first Integrated IC for Satellite Broadcasting outdoor unit in BiCMOS technology.
- MBA from University of Leicester, UK and Bachelor of Electrical Engineering from Jadavpur University, India
Management

Kiran Bhatt
Consulting Vice President, Operations
(MS EE, Univ. of Cincinnati, Ohio. MS Physics, Gujarat Univ., India.)
RFIC Solutions Inc. USA

- 32 years of experience in the semiconductor field at fabless and with-fab IC companies.
- Twenty years at small and start-up companies. Started, built, managed and directed process, foundry management, technology development, product and test engineering groups of various sizes for digital, analog & mixed-signal, and RF/wireless products/technologies and holds one US patent.
- Experience with Bipolar and CMOS & BiCMOS technologies in Si & SiGe. Strategized, developed and managed business and engineering relationships with foundry, test and assembly partners.
- Previously worked at National Semiconductor, Advanced Micro Devices, Phillips / Signetics and Micro Linear corporations.
Design Services

We offer all types of RFIC Design service at competitive cost with our design center in India, using variety of IC processes including GaAs, AlGaAs, Silicon CMOS, SiGe BICMOS, RFCMOS for RFICs. We have designed MMIC and RFIC chipsets for UWB, WLAN, WiMax, PCS and cellular application.

- **RFIC/MMIC Design Services**
  We offer RFIC/MMIC Design services with excellent performance up to customer satisfaction at very competitive price. We better understand customer need and deliver it within desired design time frame.

- **RF Modules/Board/System Design Services**
  We provide RF Modules & boards design services to meet your requirements. We offer RF board and sub system level design layout and test. We offer complete turn-key system solution with our partners.

- **RFIC/MMIC Intellectual Property**
  We have developed 150+ RFIC building blocks covering 0-70 GHz. We can license these RFIC Design Blocks. Available Blocks: Power Amplifiers, Low Noise Amplifiers, Mixers, IF Amplifiers, Oscillators, Gain Blocks, Transceivers and Filters. In addition we provide Custom ASICs that meet your requirements.
 ➢ **Layout Design Services**

We offer a IC layout design service for RF, Analog, Digital and Mixed signal designs. We have a good layout design team with vast experience which can better understand customer need and cater to all customer requirement. Layout design with RFIC Solutions offers a faster speed and lower cost solution to their customer.

➢ **PCB Board design Services**

RFIC Solutions Inc. design team is capable of developing board solutions from a simple prototyping board to the state of the art complex RF boards. We provide a multilayer board design services up to 22 layer. We had deliver complex six layer board for WLAN and other system application. We can provide services for developing the RF Prototype boards for multi way testing of manufactured simple and complex IC's along with testing on demand.
Key Achievements & Past Experiences

- Developed more than 150 IC building blocks in CMOS and GaAs technologies
- Developed 4 complex ICs including One Giga bit data rate MIPI transceiver, 8-40 GHz synthesized source, 900 MHz transceiver etc.
- Delivered custom IC designs, IP and design services to more than 20 customers including 7 from USA, 3 from Japan, some of our customers have market cap of more than $100 Billion
- Developed a strong design team in India offering design services with high performance and low cost
- Total team experience – 100+ years in semiconductors; design, process, products, marketing, sales, technology development
- Team has 7 patents, published more than 45 papers in international journals
- Designed more than 600 RF ICs chips covering 0.01-100 GHz frequencies
- Designed with Si, SiGe, RFCMOS, CMOS, BiCMOS, GaAs, AlGaAs and other processes
RFIC Designs Frequency Capability

Design Team at RFIC Solutions, Inc has delivered RFIC/MMIC and Mixed Signal Solutions up to 60 GHz.
Our Design Functional Capability

We have capability to design to address different systems

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
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<td>RF</td>
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<td>Analog</td>
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<td></td>
<td>802.11(a,b,g,n,ac), Cellular Devices &amp; Base Stations</td>
<td></td>
<td>Amplifiers, LDO, Detector, Multipliers</td>
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<tr>
<td>LNA</td>
<td>20 to 60</td>
<td>LNA</td>
<td>0.4 to 10</td>
<td>Programmable Gain Amplifier (PGA)</td>
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<td>Power Amplifiers</td>
<td>20 to 60</td>
<td>Complex Band Pass Filter (CBPF)</td>
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<td>RX Mixer</td>
<td>20 to 60</td>
<td>RX Mixer + TIA</td>
<td>0.9</td>
<td>PLL</td>
<td>1 to 2.8</td>
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<tr>
<td>TX Mixer</td>
<td>20 to 60</td>
<td>LNA + RX Mixer + TIA</td>
<td>0.9</td>
<td>Band Gap Reference</td>
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<td>VCO</td>
<td>20 to 60</td>
<td>PA + LPF + ATT</td>
<td>0.9</td>
<td>Gain Control Amplifier</td>
<td>0.4 to 1</td>
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<td>Driver Amplifier</td>
<td>20 to 40</td>
<td>CBPF + PGA</td>
<td>0.9</td>
<td>OPAMP</td>
<td>0.1</td>
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<td>RX Mixer</td>
<td>20 to 60</td>
<td>LNA + Mixer + CBPF + PGA</td>
<td>0.9</td>
<td>Phase Frequency Detector</td>
<td>0 to 2</td>
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<td></td>
<td></td>
<td>TX PA</td>
<td>0.8 to 20</td>
<td>Frequency Multiplier</td>
<td>10 to 20</td>
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<td>Synthesizers</td>
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<td>Attenuator</td>
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<td>VCO</td>
<td></td>
<td>10 to 20</td>
<td></td>
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<td></td>
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<tr>
<td>LO + Buffer</td>
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<td>XTAL Buffer</td>
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<tr>
<td>Programmable Frequency Divider</td>
<td>0.9 to 20</td>
<td>Gain Control Amplifier</td>
<td>1 to 6</td>
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<td></td>
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<td>Driver Amplifier</td>
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<td>RF Switch</td>
<td>0.01 to 20</td>
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<td>CATV Amplifier</td>
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<td>0 to 6</td>
<td></td>
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<td>Differential Amplifier</td>
<td>0.04 to 0.87</td>
<td>10 to 20</td>
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<td>Oscillators</td>
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<td>Complete Transceiver PHY</td>
<td>14 to 16</td>
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<tr>
<td>Complete Receiver PHY</td>
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<td>Complete Receiver PHY</td>
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### Design Experiences

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<th>Process Nodes</th>
<th>Freq. Range</th>
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<td>Transceivers</td>
<td>CMOS</td>
<td>TSMC</td>
<td>350nm to 65nm</td>
<td>DC to 60 GHz</td>
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<td>Cellular (GSM, LTE, WCDMA)</td>
<td>LNA</td>
<td>SiGe BiCMOS</td>
<td>WIN Semiconductor</td>
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<td>Cellular Basestations</td>
<td>Power Amplifiers</td>
<td>GaAs pHEMT</td>
<td>TriQuint</td>
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<td>Ultrawideband (UWB)</td>
<td>Oscillators (Voltage Controlled &amp; Fixed)</td>
<td>InGaP HBT</td>
<td>TowerJazz</td>
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<td>IEEE 802.11 a/b/g/ac/ad</td>
<td>Mixers</td>
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<td>GCS</td>
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<td>Wi-Fi</td>
<td>Synthesizers</td>
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<td>WLAN</td>
<td>Phase Locked Loop (PLL)</td>
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<td>Bluetooth</td>
<td>Attenuators</td>
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<td>RF Front End Module (FEM)</td>
<td>Switches</td>
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<td>Zig-Bee</td>
<td>Low-Dropout Regulators (LDO)</td>
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<td>WiMax</td>
<td>Filters</td>
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<td>GPS</td>
<td></td>
<td></td>
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<tr>
<td>CATV/HFC</td>
<td></td>
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<td></td>
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<tr>
<td>RFID</td>
<td></td>
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</tbody>
</table>
Product Expertise Area

We have IC design expertise in following market segments/components

**Components**
- RF/Wireless & wired transceiver
- Power management
- PLLs
- Low noise amplifiers
- Power amplifiers
- Oscillators
- Filters
- High speed I/Os

**Markets**
- WiFi
- Cellular
- WiMax
- CATV/HFC
- Fiber optic
- High speed digital / LVDS/DDR3/PCI Express/HDMI

Our Market ➔
Local high throughput delivery

Wired / Wireless

Wired / Wireless

Long range delivery wired & wireless (backbone)

Wired / Wireless

Wired / Wireless
Infrastructure and Facility

- Facilities – 20 work stations for RF IC/Module design with best industry proven Electronic Design Tool
  - Cadence-Virtuoso Layout Editor & Assura
  - Agilent-Advanced Design System
  - AWR-Microwave Office & Analog Office,
  - IC Editor, Eagelware, Mentor Graphic, Microwind
  - Altium, cadence Orcad, express PCB, Spice
  - Microsoft Visio
  - AutoCAD and other engineering software
  - Xilinx ISE Design suite & Altera Quartas II for FPGA design & development

- Projects: Consulting and design work on components and sub systems for WLAN, MIMO systems, WiMax, Ultra Wide band (UWB), High speed I/Os wire line systems.

- Offer high quality RF, Analog, Digital & Mixed-Signal design services at competitive price
RFIC Solutions has testing capability using state-of-the-art test instruments like Wafer Probes station, Vector Network Analyzers, Spectrum Analyzers, Noise Figure Meters, and Digital Oscilloscopes (>40 Gsps).

- Wafer Level Testing to characterize RFIC/MMIC using Wafer Probe station
- S-parameter Characterization, Load Pull Measurements using Vector Network Analyzer
- Noise Figure Characterization using NF Meters
- Frequency Domain Measurements like Inter Modulation Distortion and Phase noise using Spectrum Analyzer
- Time Domain Measurement using Oscilloscopes
Prototyping

- RFIC Solutions has expertise in delivering units in prototype quantities ranging from 1-100 units.
ANALOG AND MIXED SIGNAL DESIGNS

Summary
PLL developed by RFIC Solutions

Electrical specifications:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Descriptions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
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<tbody>
<tr>
<td>VCO</td>
<td>Frequency Range</td>
<td>500</td>
<td></td>
<td>1000</td>
<td>MHz</td>
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<tr>
<td></td>
<td>Tuning Voltage</td>
<td>0.6</td>
<td></td>
<td>1.8</td>
<td>V</td>
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<td></td>
<td>Phase noise@100 KHz offset</td>
<td>–115</td>
<td></td>
<td></td>
<td>dBc/Hz</td>
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<tr>
<td></td>
<td>Phase noise@1MHz Offset</td>
<td>-140</td>
<td></td>
<td></td>
<td>dBc/Hz</td>
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<td>Phase Frequency Detector (PFD)</td>
<td>PFD frequency</td>
<td>10</td>
<td></td>
<td></td>
<td>MHz</td>
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<tr>
<td>Charge Pump</td>
<td>Icp Source/sink</td>
<td>.9</td>
<td></td>
<td>2.8</td>
<td>mA</td>
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<td>Dual Mode Divider</td>
<td>Division Range</td>
<td>16</td>
<td></td>
<td>127</td>
<td></td>
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<tr>
<td>IQ Generator</td>
<td>Phase difference</td>
<td>90</td>
<td></td>
<td></td>
<td>Degree</td>
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<tr>
<td></td>
<td>Frequency Range</td>
<td>250</td>
<td></td>
<td>500</td>
<td>MHz</td>
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</tbody>
</table>

Architecture: (Fout 500 – 1000 MHz)

Features:

1. On-Chip VCO tunes from 500 MHz to 1000 MHz
2. Programmable Divider (16-127 division)
3. High Speed In-Phase & Quadrature-Phase output Signal (250-500 MHz)
4. Low Speed Signal (15-30 MHz)
5. Different Reference Frequency (10-40 MHz)
6. Low dynamic power consumption in locked state
7. Prescalar 4/5
8. Duty cycle (45% to 55%)
9. Temperature stability (-40 to +125° C)
PLL developed by RFIC Solutions

PLL Layout

Charge pump Layout

Locking Condition
Complex CMOS MIPI Transceiver chip with PLL, LDO developed by RFIC Solutions

- Latest mobile standard complaint
- Applications: - Mobile Phone Camera interface
- Mobile Phone Display interface
802.15.4g CMOS 915 MHz Transceiver developed by RFIC Solutions

- 130 nm CMOS technology node
- RFIC Solutions developed the RF circuits and some digital blocks.
- Chip size 4.3x4.3 mm includes RF and Baseband circuits
- Features – low current – 15 mA Rx and 17 mA Tx with BB, low power, low cost,
DIGITAL DESIGNS

Summary
Digital Control Interface – RDCI12

- RFIC-Digital Control Interface allows dynamic control of analog, RF modules and their modes of operation. RFIC DCI is implemented on 130 nm RF CMOS Low Power process technology.
- A Serial Peripheral Interface (SPI) with clock speed in GHz can be achieved to program the control registers.
- Digital Control Interface used in GHz Transceivers and other wireless communication devices.
Poly Phase Programmable Frequency Divider

- This Poly phase CMOS Programmable Frequency Divider IP fabricated on 130 nm low power RF CMOS Technology. The module contains decoder logic, Divider logic and a multiplexer logic. This frequency divider gives the output in poly phase form with four different output phase.

Programmable Frequency Divider

- Wide range of frequency (50-2400 MHz) can be provided as input clock and programmable divider will be responsible for dividing the frequency by a particular frequency divider ration.
RFIC/MMIC TAPE OUTS COMPLETED
180nm SiGe BiCMOS Process

- Three SiGe BiCMOS/RFCMOS IC design tape outs on 180nm process.
- 15+ designs like LNA, Power amplifiers, drivers for WLAN and WCDMA applications.
- VCO, high speed drivers, mixers were also designed and fabricated on these masks.

The picture above shows one of the IC tile on BiCMOS process having LNA, PA and driver amplifier designs for WLAN and WCDMA applications.
GaAs 0.5um PS 50-70 pHEMT Process

- 15 Designs for various wireless applications.
- Designs Covering 0.5GHz to 12GHz frequency range.
- Power amplifier designs for low to high power applications up to 0.5 Watt.
- High performance Low noise amplifiers covering 2GHz to 8GHz.
- Other high performance designs like DA, PA, LNA, Oscillator, RF Switch, etc along with flexible amplifier test structures on the tile.
- Fabricated with Win Semi. foundry
1 Watt Power Amplifier

**Applications**
- ISM Band
- WiMax standard
- GSM, CDMA, TDSCDMA, WCDMA
- Single and Multi-Carrier Applications

**Key Features**
- High output power
- Wide band operation
- Tunable
- ESD Protected

**Electrical Specification:**

<table>
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<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Achieved Specs</th>
<th>Measured Results</th>
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<tr>
<td>Gain – 2140MHz</td>
<td>dB</td>
<td>18.7</td>
<td>16</td>
</tr>
<tr>
<td>S11</td>
<td>dB</td>
<td>9.8</td>
<td>-</td>
</tr>
<tr>
<td>S22</td>
<td>dB</td>
<td>8.2</td>
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<tr>
<td>P1dB</td>
<td>dB</td>
<td>30</td>
<td>-</td>
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<tr>
<td>Pout -50dBc WCDMA</td>
<td>dB</td>
<td>20.4</td>
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<tr>
<td>Current -50dBc WCDMA Pout</td>
<td>mA</td>
<td>238</td>
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<tr>
<td>NF</td>
<td>dB</td>
<td>5</td>
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<tr>
<td>Voltage</td>
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<tr>
<td>Quiescent Current</td>
<td>mA</td>
<td>240</td>
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</table>
CATV Amplifier, (40 - 870 MHz)

- Measured Data

Gain Vs Freq.

Noise Fig. Vs Freq.

CATV Module

I/P Reflection coeff. Vs Freq.

O/P Reflection coeff. Vs Freq.

CATV die Photograph
Partial listing of our design IPs

SiGe BiCMOS and CMOS IPs:

<table>
<thead>
<tr>
<th>S.N</th>
<th>Part No.</th>
<th>Frequency</th>
<th>IP Name &amp; Process</th>
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<tbody>
<tr>
<td>1</td>
<td>RIBPL01</td>
<td>1100 MHz</td>
<td>Phase Locked Loop, RF CMOS</td>
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<tr>
<td>2</td>
<td>RTPL01</td>
<td>1100 MHz</td>
<td>Phase Locked Loop, RF CMOS</td>
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<tr>
<td>3</td>
<td>RCLRX01</td>
<td></td>
<td>Low Speed, low power Receiver IP</td>
</tr>
<tr>
<td>4</td>
<td>RCLTX01</td>
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<td>Low Speed, low power Transmitter IP</td>
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<td>5</td>
<td>RTDA01</td>
<td>2.0 to 5.0 GHz</td>
<td>Driver Amplifier, RF CMOS</td>
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<td>6</td>
<td>RTLNA01</td>
<td>2 to 4 GHz</td>
<td>Low Noise Amplifier, RF CMOS</td>
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<td>RCLDO1</td>
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<td>Low Drop out regulator, CMOS</td>
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<td>8</td>
<td>RCBGR1</td>
<td>1.5 to 1.7 GHz</td>
<td>Band Gap reference, CMOS</td>
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<td>9</td>
<td>RJL01</td>
<td>1.5 to 1.7 GHz</td>
<td>Narrow band GPS LNA, SiGe BiCMOS</td>
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<td>10</td>
<td>RJL02</td>
<td>1575 MHz</td>
<td>Narrow band GPS LNA, SiGe BiCMOS</td>
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<td>11</td>
<td>RJP01</td>
<td>1.920 to 1.980 GHz</td>
<td>WCDMA PA, SiGe BiCMOS</td>
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<td>RS01</td>
<td>1.7 to 2.7 GHz</td>
<td>Single Stage LNA, SiGe BiCMOS</td>
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<td>RS03</td>
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<td>RJP05</td>
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<td>WLAN PA, SiGe BiCMOS</td>
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</tbody>
</table>

- Samples of 2-6 GHz LNA, 2-10 GHz LNA, 2-5 GHz driver amp, 0.05-3.5 GHz LNA, CATV amp on GaAs. products are available today on request.
### Partial listing of our design IPs

**RF CMOS IPs @915 MHz**

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Designs</th>
<th>IP Name</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low Noise amplifier</td>
<td>RLNTA12</td>
<td>Transform Domain (TD) receiver and ISM</td>
</tr>
<tr>
<td>2</td>
<td>Tone generator</td>
<td>RTG12</td>
<td>For calibration in receiver (Tuning of filter center frequency) and as a Transmitter</td>
</tr>
<tr>
<td>3</td>
<td>RF CMOS Power Amplifier</td>
<td>RPA12C</td>
<td>Application Based Short Distance Communication</td>
</tr>
<tr>
<td>4</td>
<td>CBPF</td>
<td>RCBPF01</td>
<td>General Purpose System, Portable system, Anti-Alias Filter, Tracking Filter, Harmonic analysis, Noise analysis, Reconstruction Filters</td>
</tr>
<tr>
<td>5</td>
<td>PGA</td>
<td>RCPGA01</td>
<td>Analog input amplifier for Analog to Digital Converter, Digitally controlled attenuators, Programmable gain amplifiers, Function generation, Linear automatic gain controls</td>
</tr>
<tr>
<td>6</td>
<td>Digital Control Interface for wireless Applications</td>
<td>RDCI12</td>
<td>Wireless Communication, GHz Transceivers</td>
</tr>
<tr>
<td>7</td>
<td>Poly Phase CMOS Programmable Frequency Divider</td>
<td>RPD12</td>
<td>PLL Frequency synthesizers, LNA's and Tone Generators</td>
</tr>
<tr>
<td>8</td>
<td>CMOS Programmable Frequency Divider</td>
<td></td>
<td>PLL Frequency synthesizers, LNA's and Tone Generators</td>
</tr>
</tbody>
</table>
### Partial listing of our design IPs

#### GaAs p-HEMT IPs:

<table>
<thead>
<tr>
<th>S.N</th>
<th>Part No.</th>
<th>Frequency</th>
<th>IP Name &amp; Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RGDA01</td>
<td>2.0 to 4.0 GHz</td>
<td>Driver Amplifier,</td>
</tr>
<tr>
<td>2</td>
<td>RGLNA02</td>
<td>2.0 to 6.0 GHz</td>
<td>Low Noise Amplifier,</td>
</tr>
<tr>
<td>3</td>
<td>RGLNA03</td>
<td>2.0 to 12.0 GHz</td>
<td>Low Noise Amplifier,</td>
</tr>
<tr>
<td>4</td>
<td>RGLNA01</td>
<td>0.7 to 3.0 GHz</td>
<td>Low Noise Amplifier,</td>
</tr>
<tr>
<td>5</td>
<td>RGLNA10</td>
<td>7.0 to 26.0 GHz</td>
<td>Low Noise Amplifier,</td>
</tr>
<tr>
<td>6</td>
<td>RGLNA11</td>
<td>2.0 to 6.0 GHz</td>
<td>Low Noise Amplifier,</td>
</tr>
<tr>
<td>7</td>
<td>RGLNA06</td>
<td>2.0 to 6.0 GHz</td>
<td>Low Noise Amplifier,</td>
</tr>
<tr>
<td>8</td>
<td>RDA03</td>
<td>2.0 to 4.0 GHz</td>
<td>Driver Amplifier</td>
</tr>
<tr>
<td>9</td>
<td>RTV01</td>
<td>40 to 870 MHz</td>
<td>CATV Amplifier,</td>
</tr>
<tr>
<td>10</td>
<td>RGPA03</td>
<td>3.4 to 3.6 GHz</td>
<td>Power Amplifier,</td>
</tr>
<tr>
<td>11</td>
<td>RGPA04</td>
<td>4.9 to 5.9 GHz</td>
<td>Power Amplifier,</td>
</tr>
<tr>
<td>12</td>
<td>RGPA01</td>
<td>2.4 to 2.5 GHz</td>
<td>Power Amplifier,</td>
</tr>
<tr>
<td>13</td>
<td>RGPA05</td>
<td>1.85 to 1.91 GHz</td>
<td>Power Amplifier,</td>
</tr>
<tr>
<td>14</td>
<td>RFISFRT01</td>
<td>2.4 to 2.5 GHz</td>
<td>WLAN Front End,</td>
</tr>
<tr>
<td>15</td>
<td>RFISFR01</td>
<td>2.5 to 2.686 GHz</td>
<td>Front End Module,</td>
</tr>
<tr>
<td>16</td>
<td>RGPA</td>
<td>880 to 960 MHz</td>
<td>5 watt, PA,</td>
</tr>
</tbody>
</table>

#### GaAs InGaP HBT IPs

<table>
<thead>
<tr>
<th>S.N</th>
<th>Part No.</th>
<th>Frequency</th>
<th>IP Name &amp; Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GEDA01</td>
<td>7 to 20 GHz</td>
<td>Driver Amplifier,</td>
</tr>
<tr>
<td>2</td>
<td>GEDA01</td>
<td>20 to 40 GHz</td>
<td>Driver Amplifier,</td>
</tr>
<tr>
<td>3</td>
<td>GEV03</td>
<td>15 to 20 GHz</td>
<td>VCO,</td>
</tr>
<tr>
<td>4</td>
<td>GRV02</td>
<td>10 to 15 GHz</td>
<td>VCO,</td>
</tr>
<tr>
<td>5</td>
<td>GRFM1</td>
<td>10 to 20 GHz</td>
<td>Freq. Multiplier,</td>
</tr>
<tr>
<td>6</td>
<td>RGDIV01</td>
<td>7 to 20 GHz</td>
<td>Divide by 8,</td>
</tr>
<tr>
<td>7</td>
<td>RWPA01</td>
<td>2.3 to 2.7 GHz</td>
<td>Power amplifier,</td>
</tr>
<tr>
<td>8</td>
<td>GRDA1</td>
<td>10 to 20 GHz</td>
<td>Differential Amplifier,</td>
</tr>
<tr>
<td>9</td>
<td>GRO1</td>
<td>14 to 16 GHz</td>
<td>High Freq. Oscillator,</td>
</tr>
<tr>
<td>10</td>
<td>GRV03</td>
<td>14 to 21 GHz</td>
<td>Negative Resistance Generator,</td>
</tr>
</tbody>
</table>
MMIC DESIGN LIBRARY
AND
SYSTEM BUILDING BLOCKS

Snapshots
SiGe BiCMOS & RF CMOS MMIC

- Cable TV Amplifier: 40 to 870 MHz
- WCDMA Power Amplifier: 1920 to 1980 MHz
- WLAN Power Amplifier: 2.4 to 2.5 GHz
- WiMAX Power Amplifier: 3.4 to 3.6 MHz
- GPS LNA with Mode Ctrl: 1.5 to 1.7 GHz
- Low Current Narrow Band GPS LNA: 1.575 MHz
- 7 GHz Voltage Controlled Oscillator
- 1.6 to 3 GHz Gilbert Cell Mixer
- 2.4 GHz LNA
- 2.5 GHz Driver Amplifier
RF CMOS MMIC

- Buffer Amplifier
- Mixer
- Crystal Oscillator
- Power Amplifier
- Attenuator
- LNA
- Digital Control Interface
- Poly phase Freq Divider
Driver and power amplifier MMIC (pHEMT technology)

RGPA01 2.4 to 2.5 GHz Power Amplifier

RGPA02 3.4 to 3.6 GHz Power Amplifier

RGPA03 3.5 GHz Power Amplifier

RGPA04 5 GHz Power Amplifier

AP2520 50 MHz to 250 MHz Power Amplifier

Cable TV Amplifier

RDA01 2-4 GHz Driver Amplifier

RGPA05 1.850 to 1.910 GHz Power Amplifier

RDA01 2-4 GHz Driver Amplifier

AP2520 50 MHz to 250 MHz Power Amplifier
InGaP HBT Synthesizer Building Blocks, 0.875-40 GHz

- 7 GHz to 20 GHz VCO
- 0.5 to 3 GHz Buffer Amplifier
- 40 GHz Gilbert Frequency Multiplier
- 7 to 20 GHz Buffer Amplifier
- 20 to 40 GHz Buffer Amplifier
- 20 GHz Frequency Multiplier
- Frequency Divider Divide by 8 Stage
SUCCESSFUL DEPLOYMENTS (COMPLEXITY, APPLICATION)
1 GHz PLL with programmable reference frequency on 0.18um CMOS process

Distinguishing Features:

- On-Chip VCO tunes from 500 MHz to 1000 MHz
- Programmable Divider (16-127 division)
- High Speed In-Phase & Quadrature-Phase output Signal (250-500 MHz)
- Low Speed Signal (15-30 MHz)
- Different Reference Frequency (10-40 MHz)
- Low dynamic power consumption in locked state
- Prescalar 4/5
- Duty cycle (45% to 55%)
- Temperature stability (-40 to +1250 C)

Applications:
- ASIC Clock Generator
- Clocking of A/D and D/A Converters
- Cellular Systems
Ultra Wideband RF/Analog Front-end for IEEE 802.15.4a standard

Distinguishing Features:
A RF/Analog Front-End board was to be designed. The board was expected to work from 3.0 GHz to 8.3 GHz.
The Board was implemented using Discrete RFIC/MMIC and consumed very less power.

Applications
Reference Design for Ultra Wideband Communication Systems
Low Data Rate Wide Band Pulse Based non-coherent Communication systems
UP Converter for CMTS system based on DOCSIS Standard

Distinguishing Features:
Low Cost complete solution for CMTS based on DFRI/DOCSIS Standard.

Applications
Cable Modem Termination System
Set-Top Box
WLAN Board system development

- We offer competitive RF Board and system level design service, RF board assembly and test service.
- We are designing WiFi, WiMax, UWB system boards along with our partners.
Conclusion

- RFIC Solutions has extensive RF, Analog, Digital & Mixed Signal IC design experience – offering RFIC, Analog, Digital ASIC design & development & Mixed-Signal IC, Module and system design services.

- Completed multiple tape-outs on E/D pHEMT GaAs HBT, Silicon CMOS, RF CMOS and SiGe BiCMOS technologies with 150 plus RFIC building blocks at various foundries.

- We offer RF IC, Analog, Digital & Mixed-Signal IC’s and Module services and IP at very competitive rates.

- We are offering 802.11b/g/n, ac, ad and Blue tooth, RF Circuit IP which are currently under development.

- Currently funded privately.

- Looking for strategic customers / partners.
THANK YOU!