

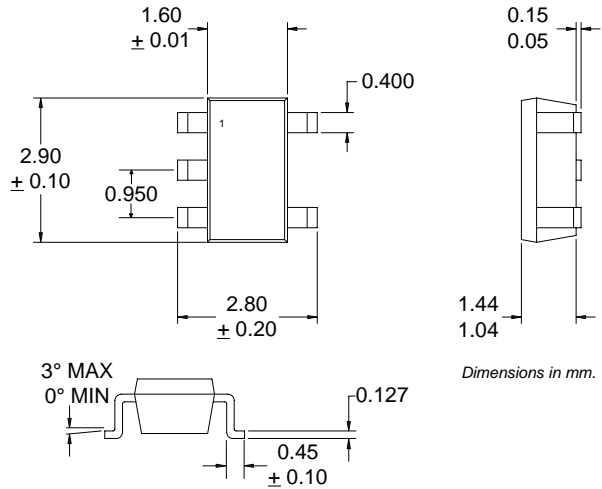
Typical Applications

- TDMA/CDMA/FM Cellular PCS LNA
- Low Noise Transmit Driver Amplifier
- General Purpose Amplification
- Commercial and Consumer Systems

Product Description

The RF2361 is a low noise amplifier with a very high dynamic range designed for digital cellular applications. The device functions as an outstanding front end low noise amplifier or power amplifier driver amplifier in the transmit chain of digital subscriber units where low transmit noise power is a concern. When used as an LNA, the bias current can be set externally. When used as a PA driver, the IC can operate directly from a single cell Li-ion battery and includes a power down feature that can be used to completely turn off the device. The IC is featured in a standard SOT 5-lead plastic package.

NOTE: The RF2361 is a non-Pb-free product. If a Pb-free product with the same functionality and package is desired, please see the RF2878.



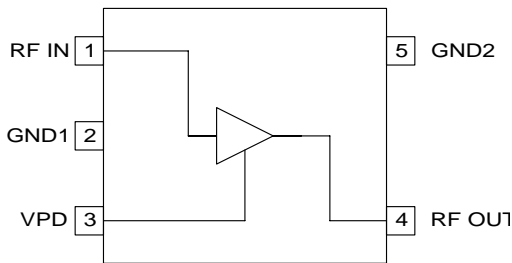
Optimum Technology Matching® Applied

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|-------------------------------------|--|---------------------------------------|
| <input type="checkbox"/> Si BJT | <input checked="" type="checkbox"/> GaAs HBT | <input type="checkbox"/> GaAs MESFET |
| <input type="checkbox"/> Si Bi-CMOS | <input type="checkbox"/> SiGe HBT | <input type="checkbox"/> Si CMOS |
| <input type="checkbox"/> InGaP/HBT | <input type="checkbox"/> GaN HEMT | <input type="checkbox"/> SiGe Bi-CMOS |

Package Style: SOT 5-Lead

Features

- Low Noise and High Intercept Point
- Adjustable Bias Current
- Power Down Control
- Single 2.5V to 6.0V Power Supply
- 150MHz to 2500MHz Operation
- Extremely Small SOT 5-Lead Package



Functional Block Diagram

Ordering Information

| | |
|---------------|--|
| RF2361 | 3V Low Noise Amplifier/ 3V PA Driver Amplifier |
| RF2361 PCBA-D | Fully Assembled Evaluation Board (Driver) |
| RF2361 PCBA-L | Fully Assembled Evaluation Board (LNA) |

| | |
|--|---|
| RF Micro Devices, Inc. 7628 Thorndike Road Greensboro, NC 27409, USA | Tel (336) 664 1233 Fax (336) 664 0454 http://www.rfmd.com |
|--|---|

RF2361

Absolute Maximum Ratings

| Parameter | Rating | Unit |
|-------------------------------|---------------|-------------|
| Supply Voltage, V_{CC} | -0.5 to +8.0 | V_{DC} |
| Power Down Voltage, V_{PD} | $\leq V_{CC}$ | V_{DC} |
| Input RF Level | +10 | dBm |
| Operating Ambient Temperature | -40 to +85 | $^{\circ}C$ |
| Storage Temperature | -40 to +150 | $^{\circ}C$ |



Caution! ESD sensitive device.

RF Micro Devices believes the furnished information is correct and accurate at the time of this printing. However, RF Micro Devices reserves the right to make changes to its products without notice. RF Micro Devices does not assume responsibility for the use of the described product(s).

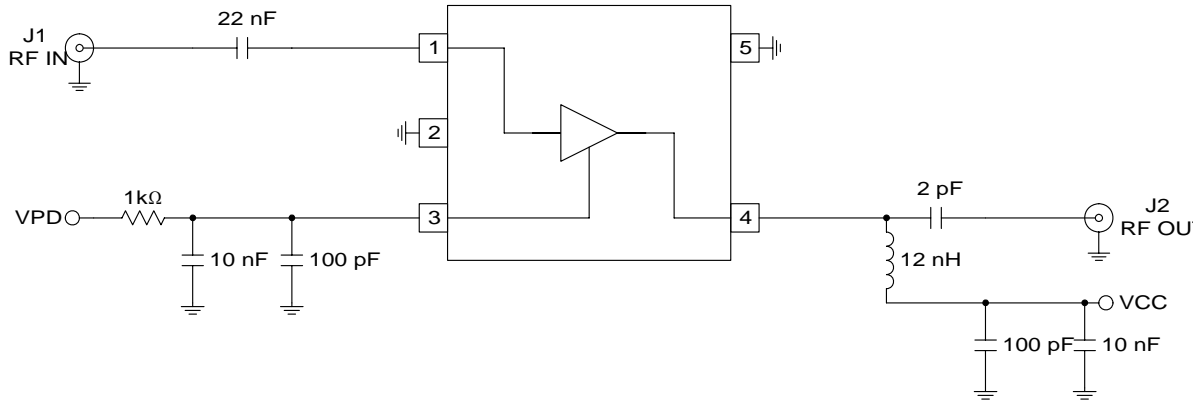
| Parameter | Specification | | | Unit | Condition |
|--|---------------|-------------|-------|------|--|
| | Min. | Typ. | Max. | | |
| Overall RF Frequency Range | | 150 to 2500 | | MHz | |
| Low Noise Amplifier 881 MHz Performance | | | | | Schematic per LNA Application; T=25 $^{\circ}C$, RF=881 MHz, V_{PD} =2.8V, R1=1k Ω |
| Gain | 19.5 | 20 | | dB | V_{CC} =3.0V, I_{CC} =7.6mA |
| | 19.5 | 20 | | dB | V_{CC} =2.7V, I_{CC} =7.5mA |
| Noise Figure | | 1.4 | 1.6 | dB | V_{CC} =3.0V, I_{CC} =7.6mA |
| | | 1.4 | 1.6 | dB | V_{CC} =2.7V, I_{CC} =7.5mA |
| Input IP3 | | +6.0 | | dBm | V_{CC} =3.0V, I_{CC} =7.6mA |
| | | +5.5 | | dBm | V_{CC} =2.7V, I_{CC} =7.5mA |
| Low Noise Amplifier 1950MHz Performance | | | | | Schematic per LNA Application; T=25 $^{\circ}C$, RF=1950MHz, V_{PD} =2.8V, R1=1k Ω |
| Gain | 12.5 | 13 | | dB | V_{CC} =3.0V, I_{CC} =6.4mA |
| | 12.5 | 13 | | dB | V_{CC} =2.7V, I_{CC} =6.3mA |
| Noise Figure | | 1.3 | 1.5 | dB | V_{CC} =3.0V, I_{CC} =6.4mA |
| | | 1.3 | 1.5 | dB | V_{CC} =2.7V, I_{CC} =6.3mA |
| Input IP3 | | +16.5 | | dBm | V_{CC} =3.0V, I_{CC} =6.4mA |
| | | +16.0 | | dBm | V_{CC} =2.7V, I_{CC} =6.3mA |
| Driver Amplifier 836MHz Performance | | | | | Schematic per Driver Amplifier Application; T=25 $^{\circ}C$, RF=836MHz, V_{PD} =2.8V |
| Gain | 19.5 | 20.5 | 21.5 | dB | V_{CC} =3.5V |
| | 19.5 | 20.5 | 21.5 | dB | V_{CC} =3.0V |
| | 19.5 | 20.5 | 21.5 | dB | V_{CC} =2.7V |
| Output IP3 | 25 | +32.0 | 35 | dBm | V_{CC} =3.5V |
| | | +29.0 | | dBm | V_{CC} =3.0V |
| | | +27.8 | | dBm | V_{CC} =2.7V |
| Noise Figure | | 1.9 | 2.0 | dB | V_{CC} =3.5V |
| | | 1.85 | 2.0 | dB | V_{CC} =3.0V |
| | | 1.8 | 2.0 | dB | V_{CC} =2.7V |
| Reverse Isolation | | 25 | | dB | V_{CC} =3.5V |
| | | 25 | | dB | V_{CC} =3.0V |
| | | 25 | | dB | V_{CC} =2.7V |
| Input VSWR | | 1.8:1 | 2.0:1 | | |
| Output VSWR | | 1.25:1 | 2.0:1 | | |
| P_{1dB} | 13 | 14.4 | | dBm | V_{CC} =3.5V |
| | 12 | 12.5 | | dBm | V_{CC} =3.0V |
| | 10.5 | 11.5 | | dBm | V_{CC} =2.7V |

| Parameter | Specification | | | Unit | Condition |
|--|---------------|------------|-------|------|---|
| | Min. | Typ. | Max. | | |
| Power Supply | | | | | T = 25 °C |
| Voltage (V _{CC}) | | 2.5 to 6.0 | | V | |
| Voltage (V _{PD}) | 2.7 | 2.8 | 2.9 | V | |
| Current Consumption - Driver Amplifier | 12.5 | 21.5 | 27 | mA | V _{CC} =3.5V; V _{PD} =2.8V; V _{PD} +V _{CC} - Current Consumption from V _{PD} is 2.0mA Typ. @ V _{PD} =2.8V and 3.0mA Max @ V _{PD} =2.9V |
| | 18 | 20 | 22 | mA | V _{CC} =3.5V; V _{PD} =2.7V; V _{PD} + V _{CC} |
| | 19 | 23 | 29 | mA | V _{CC} =3.5V; V _{PD} =2.9V; V _{PD} + V _{CC} |
| Power Down | | | 10 | μA | V _{CC} =3.5V; V _{PD} ≤ 0.9V |
| Driver Amplifier | | | | | Schematic per Driver Amplifier Application; T=25°C, RF=1880MHz, V _{PD} =2.8V |
| 1880MHz Performance | | | | | |
| Gain | 13.0 | 14.0 | 14.5 | dB | V _{CC} =3.5V |
| | 13.0 | 14.0 | 14.5 | dB | V _{CC} =3.0V |
| | 13.0 | 14.0 | 14.5 | dB | V _{CC} =2.7V |
| Output IP3 | 27 | +35.0 | 38 | dBm | V _{CC} =3.5V |
| | | +31.0 | | dBm | V _{CC} =3.0V |
| | | +28.8 | | dBm | V _{CC} =2.7V |
| Noise Figure | | 1.85 | 2.0 | dB | V _{CC} =3.5V |
| | | 1.8 | 2.0 | dB | V _{CC} =3.0V |
| | | 1.75 | 2.0 | dB | V _{CC} =2.7V |
| Reverse Isolation | | 19 | | dB | V _{CC} =3.5V |
| | | 19 | | dB | V _{CC} =3.0V |
| | | 19 | | dB | V _{CC} =2.7V |
| Input VSWR | | 1.6:1 | 2.0:1 | | |
| Output VSWR | | 1.6:1 | 2.0:1 | | Using External LC network used on evaluation board. |
| P _{1dB} | 14 | 15.6 | | dBm | V _{CC} =3.5V |
| | 13 | 14.1 | | dBm | V _{CC} =3.0V |
| | 12 | 13.1 | | dBm | V _{CC} =2.7V |
| Power Supply | | | | | T = 25 °C |
| Voltage (V _{CC}) | | 2.5 to 6.0 | | V | |
| Voltage (V _{PD}) | 2.7 | 2.8 | 2.9 | V | |
| Current Consumption - Driver Amplifier | 11.5 | 19.5 | 25.5 | mA | V _{CC} =3.5V; V _{PD} =2.8V; V _{PD} +V _{CC} - Current Consumption from V _{PD} is 2.0mA Typ. @ V _{PD} =2.8V and 3.0mA Max @ V _{PD} =2.9V |
| | 16 | 18 | 20 | mA | V _{CC} =3.5V; V _{PD} =2.7V; V _{PD} + V _{CC} |
| | 18 | 20.5 | 27 | mA | V _{CC} =3.5V; V _{PD} =2.9V; V _{PD} + V _{CC} |
| Power Down | | | 10 | μA | V _{CC} =3.5V; V _{PD} ≤ 0.9V |

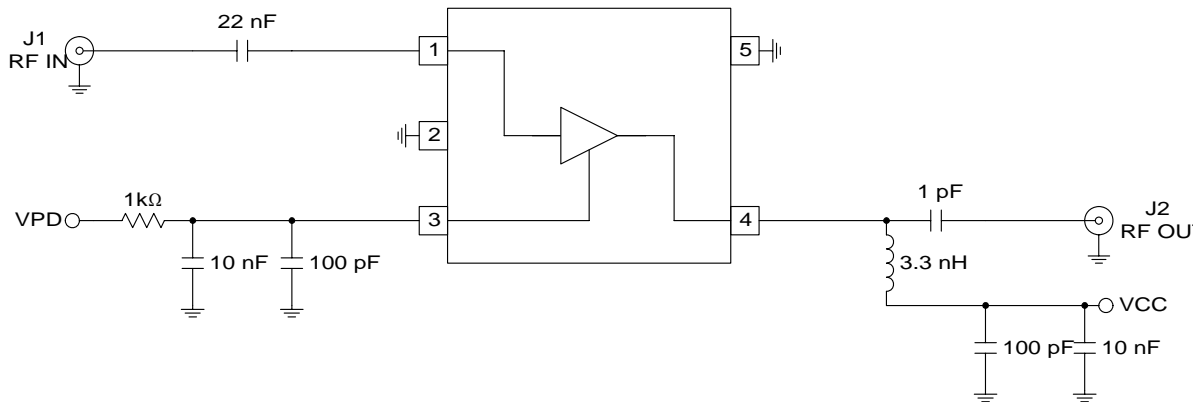
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| Pin | Function | Description | Interface Schematic |
|-----|----------|--|---------------------|
| 1 | RF IN | RF input pin. This pin is DC coupled and matched to 50Ω at 836 MHz. | |
| 2 | GND1 | Ground connection. Keep traces physically short and connect immediately to ground plane for best performance. | |
| 3 | VPD | <p>For low noise amplifier applications, this pin is used to control the bias current. See plots for bias current settings. An external resistor (R1) can be used to set the bias current for any V_{PD} voltage.</p> <p>For driver amplifier applications, this is the Power Down pin for the IC. $V_{PD}=2.8V \pm 0.1V$ is required for proper operation. $V_{PD}<0.9V$ turns off the Part. External RF bypassing is required. The trace length between the pin and the bypass capacitors should be minimized. The ground side of the bypass capacitors should connect immediately to ground plane. Nominal current required for $V_{PD}=2.8V$ is 2.0mA typical and 3.0mA Max (@ $V_{PD}=2.9V$).</p> | |
| 4 | RF OUT | Amplifier Output pin. This pin is an open-collector output. It must be biased to either V_{CC} or pin 4 through a choke or matching inductor. This pin is typically matched to 50Ω with a shunt bias/matching inductor and series blocking/matching capacitor. Refer to application schematics. | |
| 5 | GND2 | Ground connection. Keep traces physically short and connect immediately to ground plane for best performance. | |

Application Schematic:
Low Noise Amplifier ~881MHz Operation

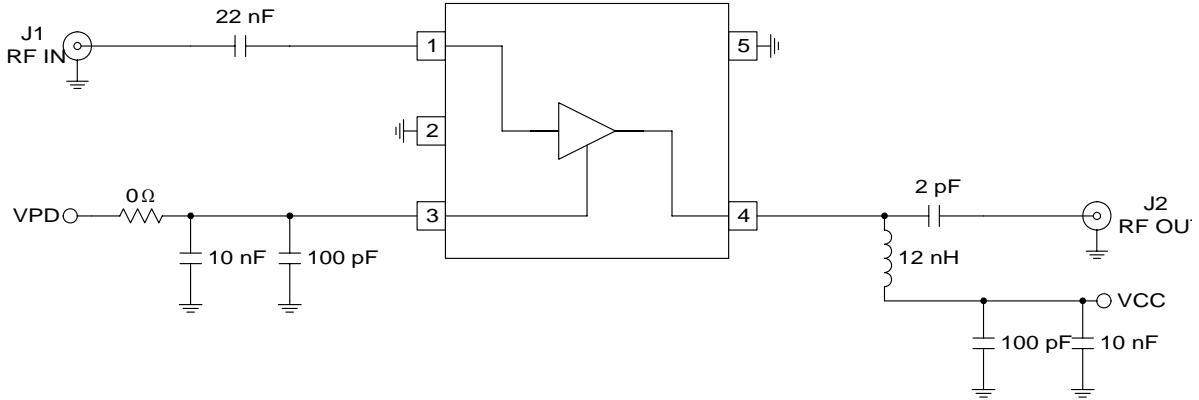


Application Schematic:
Low Noise Amplifier ~1950MHz Operation

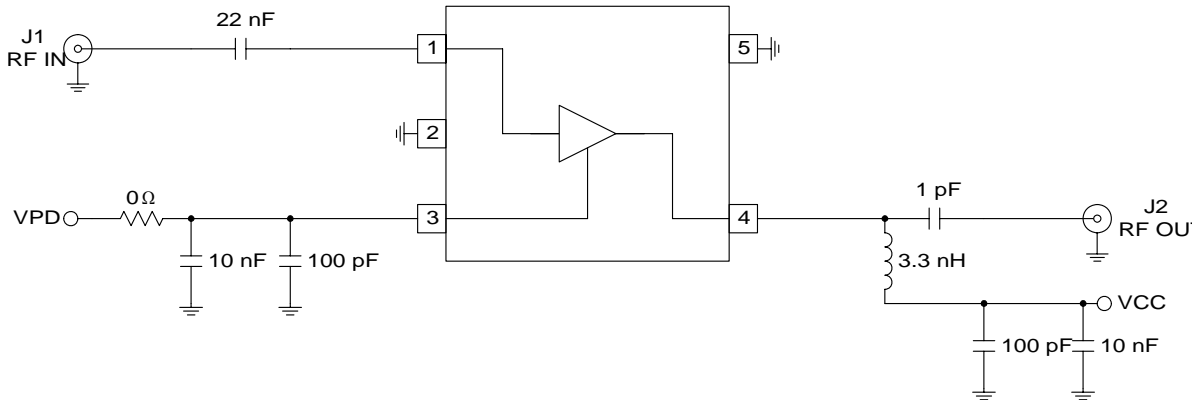


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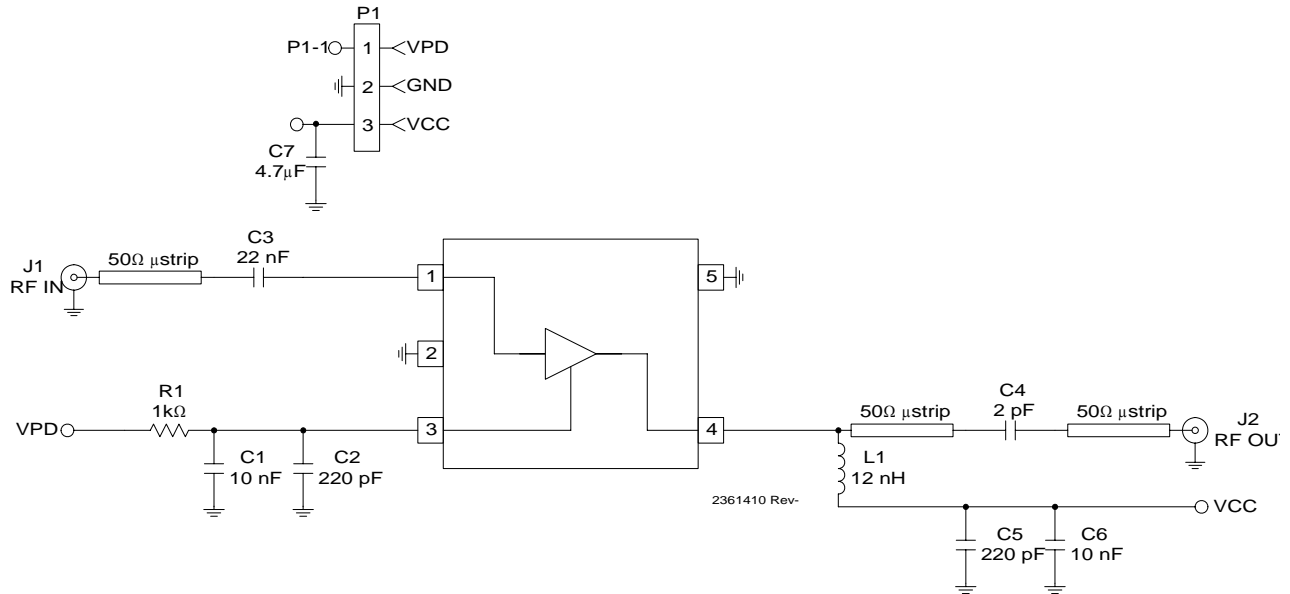
Application Schematic: Driver Amplifier ~836MHz Operation



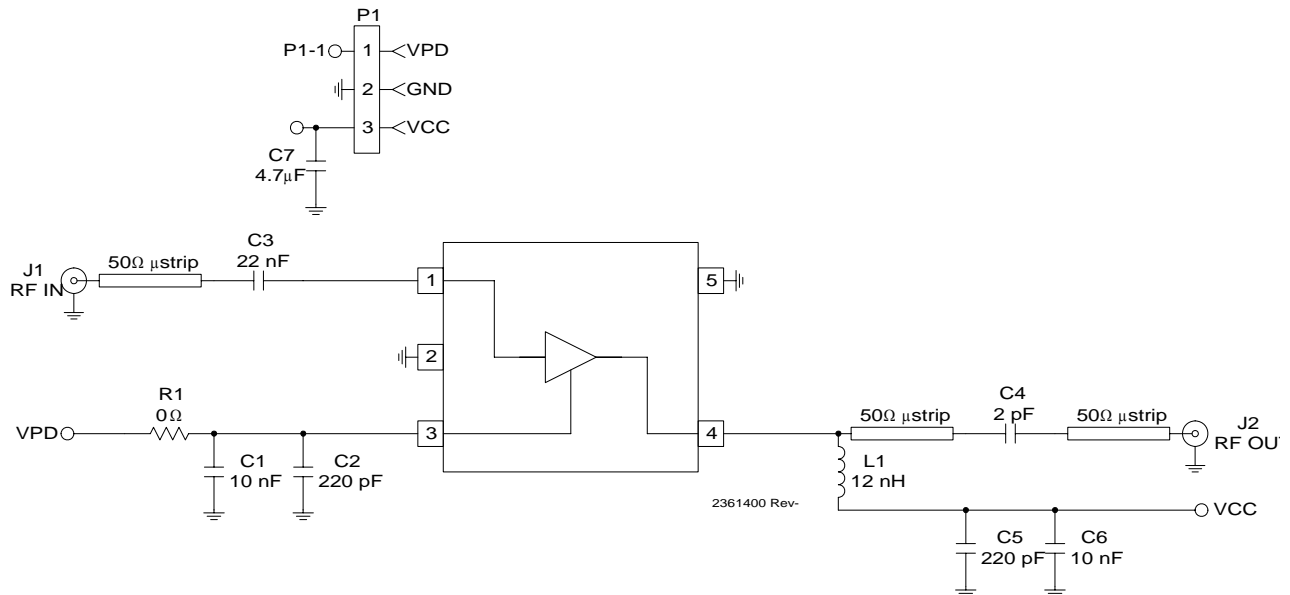
Application Schematic: Driver Amplifier ~1880MHz Operation



Evaluation Board Schematic: Low Noise Amplifier ~881MHz Operation (Download [Bill of Materials](http://www.rfmd.com) from www.rfmd.com.)

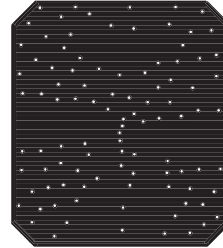
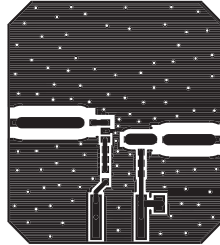
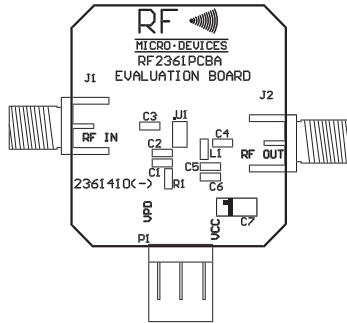


Evaluation Board Schematic: Driver Amplifier ~836MHz Operation

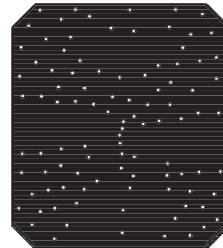
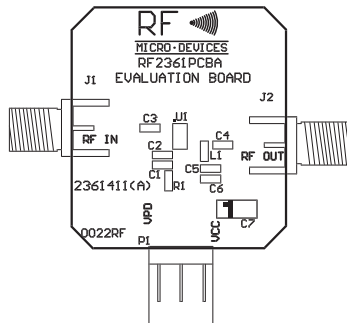


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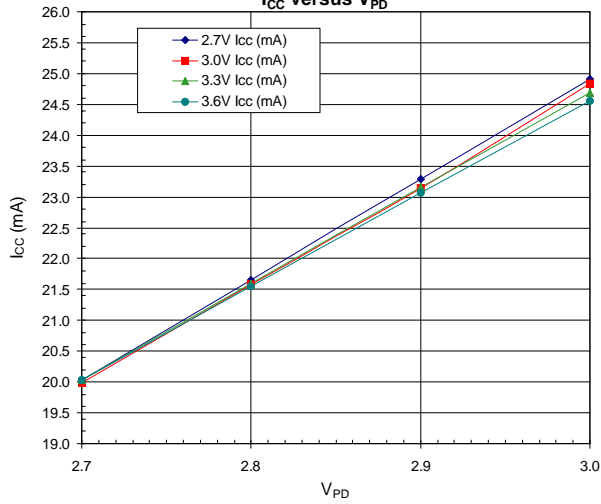
Evaluation Board Layout - 900MHz Driver
Board Size 0.948" x 1.063"
Board Thickness 0.031"; Board Material FR-4



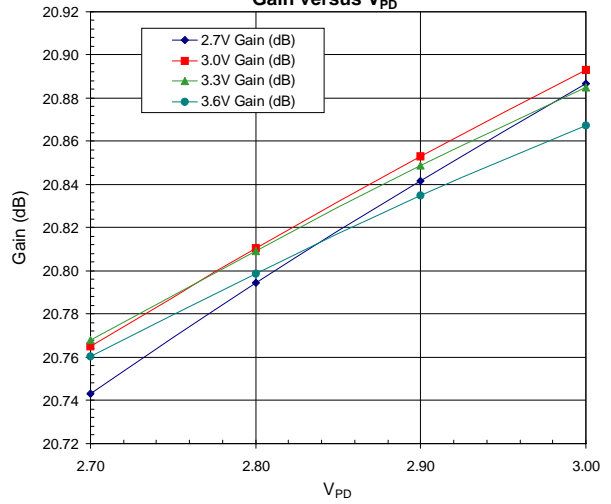
Evaluation Board Layout - 900MHz LNA



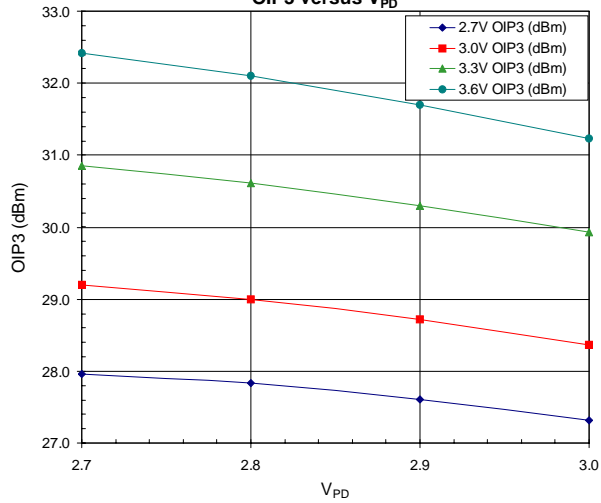
Driver Amp 836 MHz
I_{CC} versus V_{PD}



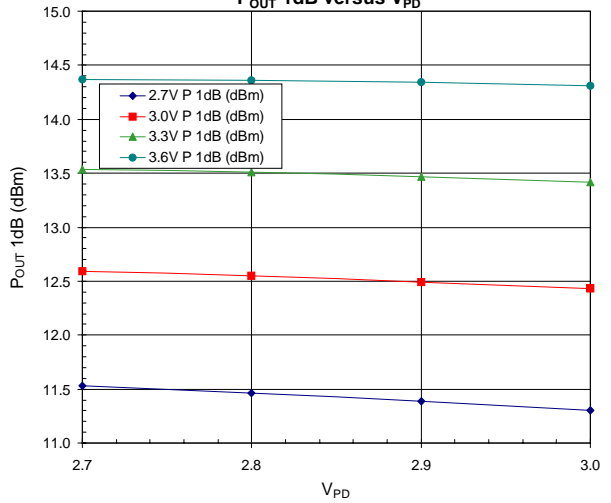
Driver Amp 836 MHz
Gain versus V_{PD}



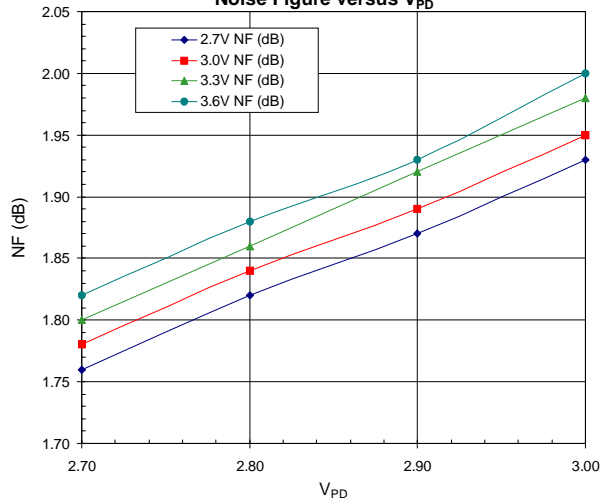
Driver Amp 836 MHz
OIP3 versus V_{PD}



Driver Amp 836 MHz
P_{OUT} 1dB versus V_{PD}

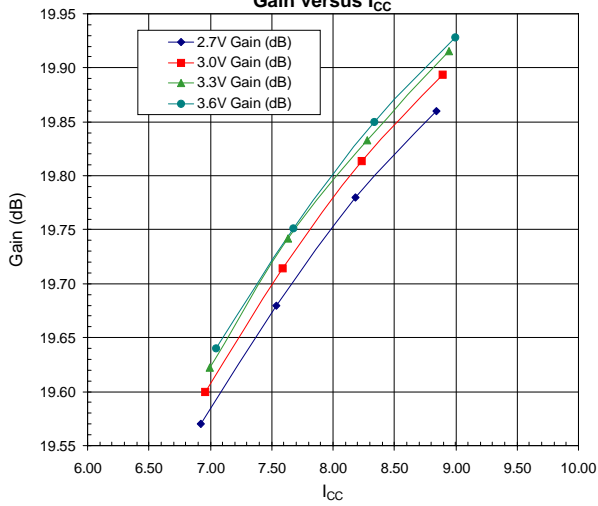


Driver Amp 836 MHz
Noise Figure versus V_{PD}

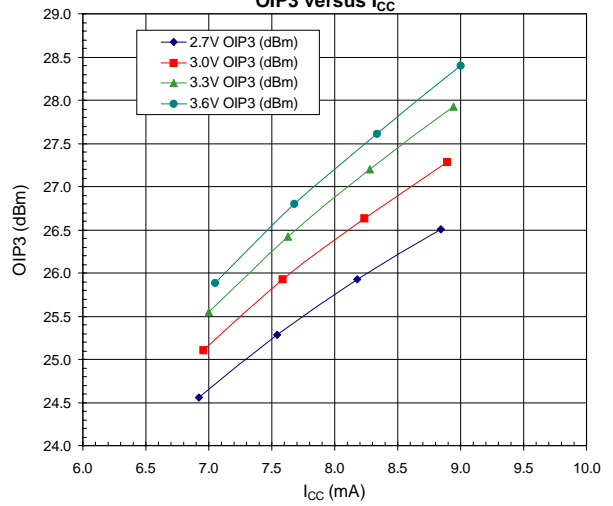


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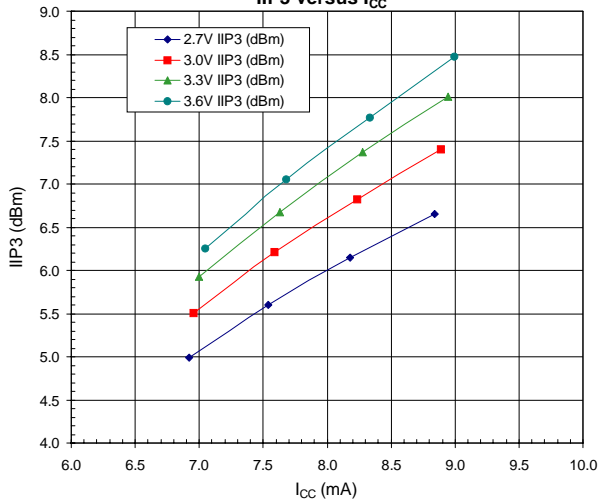
Low Noise Amplifier 881 MHz
Gain versus I_{CC}



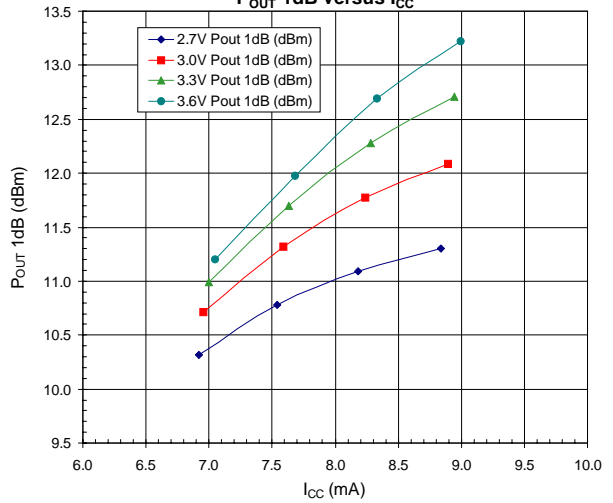
Low Noise Amplifier 881 MHz
OIP3 versus I_{CC}



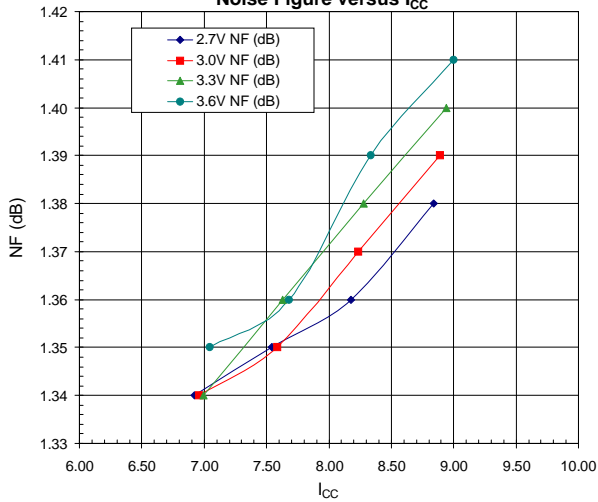
Low Noise Amplifier 881 MHz
IIP3 versus I_{CC}



Low Noise Amplifier 881 MHz
 P_{OUT} 1dB versus I_{CC}



Low Noise Amplifier 881 MHz
Noise Figure versus I_{CC}



PCB Design Requirements

PCB Surface Finish

The PCB surface finish used for RFMD's qualification process is electroless nickel, immersion gold. Typical thickness is 3μinch to 8μinch gold over 180μinch nickel.

PCB Land Pattern Recommendation

PCB land patterns are based on IPC-SM-782 standards when possible. The pad pattern shown has been developed and tested for optimized assembly at RFMD; however, it may require some modifications to address company specific assembly processes. The PCB land pattern has been developed to accommodate lead and package tolerances.

PCB Metal Land Pattern

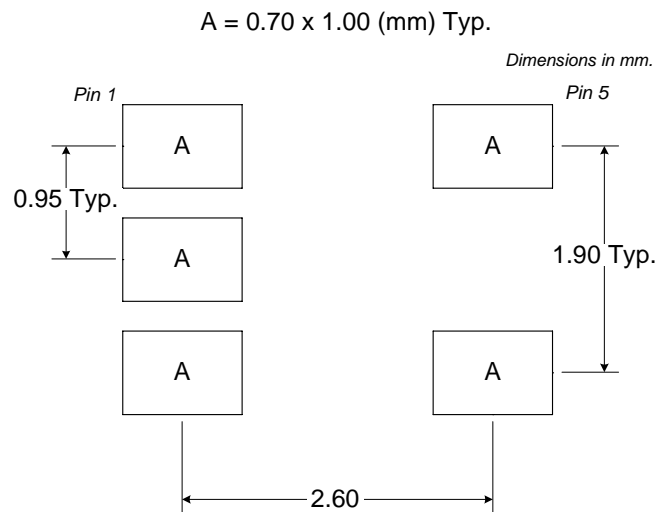


Figure 1. PCB Metal Land Pattern (Top View)

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PCB Solder Mask Pattern

Liquid Photo-Imageable (LPI) solder mask is recommended. The solder mask footprint will match what is shown for the PCB metal land pattern with a 2mil to 3mil expansion to accommodate solder mask registration clearance around all pads. The center-grounding pad shall also have a solder mask clearance. Expansion of the pads to create solder mask clearance can be provided in the master data or requested from the PCB fabrication supplier.

A = 0.90 x 1.20 (mm) Typ.

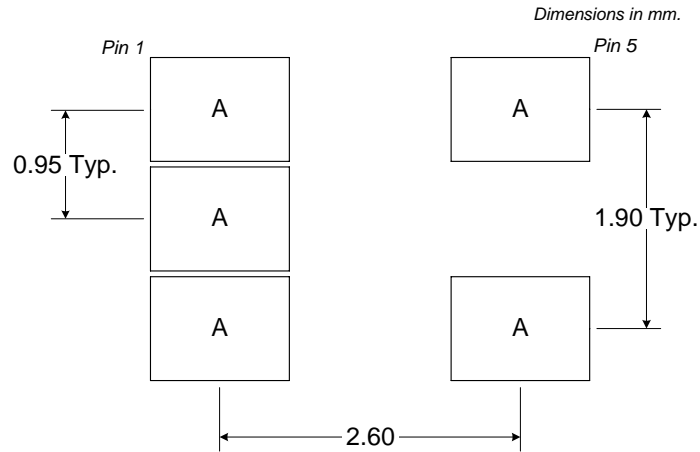


Figure 2. PCB Solder Mask (Top View)