

**RoHS Compliant & Pb-Free Product**

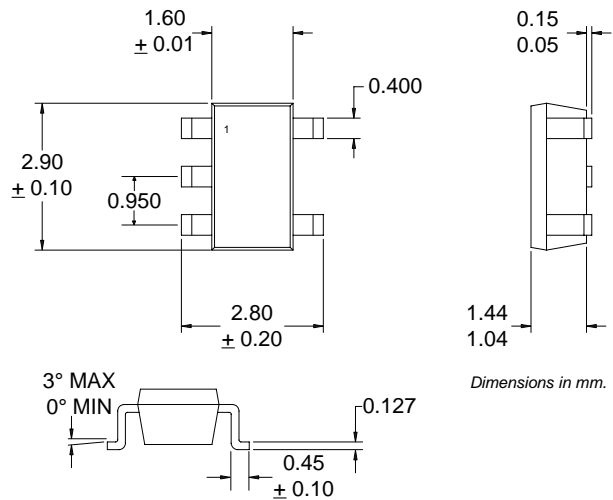
Typical Applications

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

Product Description

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



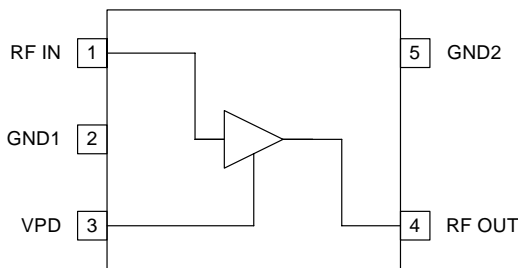
Optimum Technology Matching® Applied

- |                                     |  |                                       |
|-------------------------------------|--|---------------------------------------|
| <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

- |               |  |
|---------------|--|
| RF2878        | 3V Low Noise Amplifier/ 3V PA Driver Amplifier |
| RF2878 PCBA-D | Fully Assembled Evaluation Board (Driver)      |
| RF2878 PCBA-L | Fully Assembled Evaluation Board (LNA)         |

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# RF2878

## 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.

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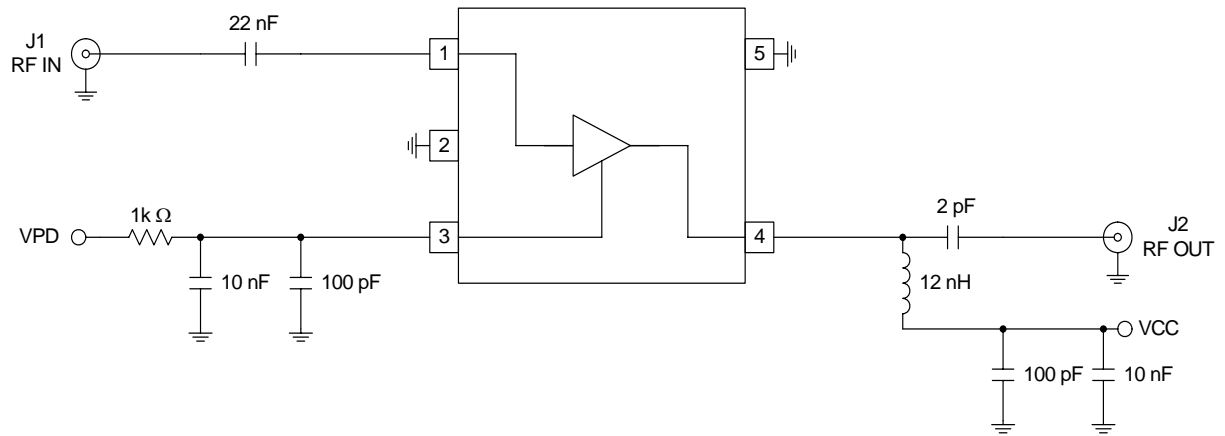
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>Overall</b> RF Frequency Range		150 to 2500		MHz	
<b>Low Noise Amplifier</b> <b>881 MHz Performance</b>					Schematic per LNA Application; T=25 $^{\circ}C$ , RF=881MHz, $V_{PD}$ =2.8V, R1=1k $\Omega$
Gain	19.5	20		dB	$V_{CC}$ =3.0V, $I_{CC}$ =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
<b>Low Noise Amplifier</b> <b>1950MHz Performance</b>					Schematic per LNA Application; T=25 $^{\circ}C$ , RF=1950MHz, $V_{PD}$ =2.8V, R1=1k $\Omega$
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
<b>Driver Amplifier</b> <b>836MHz Performance</b>					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		Using External LC network used on evaluation board.
$P_{1dB}$	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.		
<b>Power Supply</b>					T = 25 °C
Voltage (V <sub>CC</sub> )		2.5 to 6.0		V	
Voltage (V <sub>PD</sub> )	2.7	2.8	2.9	V	
Current Consumption - Driver Amplifier	12.5	21.5	27	mA	V <sub>CC</sub> =3.5V; V <sub>PD</sub> =2.8V; V <sub>PD</sub> +V <sub>CC</sub> - Current Consumption from V <sub>PD</sub> is 2.0mA Typ. @ V <sub>PD</sub> =2.8V and 3.0mA Max @ V <sub>PD</sub> =2.9V
	18	20	22	mA	V <sub>CC</sub> =3.5V; V <sub>PD</sub> =2.7V; V <sub>PD</sub> + V <sub>CC</sub>
	19	23	29	mA	V <sub>CC</sub> =3.5V; V <sub>PD</sub> =2.9V; V <sub>PD</sub> + V <sub>CC</sub>
Power Down			10	μA	V <sub>CC</sub> =3.5V; V <sub>PD</sub> ≤ 0.9V
<b>Driver Amplifier</b> <b>1880MHz Performance</b>					Schematic per Driver Amplifier Application; T=25°C, RF=1880MHz, V <sub>PD</sub> =2.8V
Gain	13.0	14.0	14.5	dB	V <sub>CC</sub> =3.5V
	13.0	14.0	14.5	dB	V <sub>CC</sub> =3.0V
	13.0	14.0	14.5	dB	V <sub>CC</sub> =2.7V
Output IP3	27	+35.0	38	dBm	V <sub>CC</sub> =3.5V
		+31.0		dBm	V <sub>CC</sub> =3.0V
		+28.8		dBm	V <sub>CC</sub> =2.7V
Noise Figure		1.85	2.0	dB	V <sub>CC</sub> =3.5V
		1.8	2.0	dB	V <sub>CC</sub> =3.0V
		1.75	2.0	dB	V <sub>CC</sub> =2.7V
Reverse Isolation		19		dB	V <sub>CC</sub> =3.5V
		19		dB	V <sub>CC</sub> =3.0V
		19		dB	V <sub>CC</sub> =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 <sub>1dB</sub>	14	15.6		dBm	V <sub>CC</sub> =3.5V
	13	14.1		dBm	V <sub>CC</sub> =3.0V
	12	13.1		dBm	V <sub>CC</sub> =2.7V
<b>Power Supply</b>					T = 25 °C
Voltage (V <sub>CC</sub> )		2.5 to 6.0		V	
Voltage (V <sub>PD</sub> )	2.7	2.8	2.9	V	
Current Consumption - Driver Amplifier	11.5	19.5	25.5	mA	V <sub>CC</sub> =3.5V; V <sub>PD</sub> =2.8V; V <sub>PD</sub> +V <sub>CC</sub> - Current Consumption from V <sub>PD</sub> is 2.0mA Typ. @ V <sub>PD</sub> =2.8V and 3.0mA Max @ V <sub>PD</sub> =2.9V
	16	18	20	mA	V <sub>CC</sub> =3.5V; V <sub>PD</sub> =2.7V; V <sub>PD</sub> + V <sub>CC</sub>
	18	20.5	27	mA	V <sub>CC</sub> =3.5V; V <sub>PD</sub> =2.9V; V <sub>PD</sub> + V <sub>CC</sub>
Power Down			10	μA	V <sub>CC</sub> =3.5V; V <sub>PD</sub> ≤ 0.9V

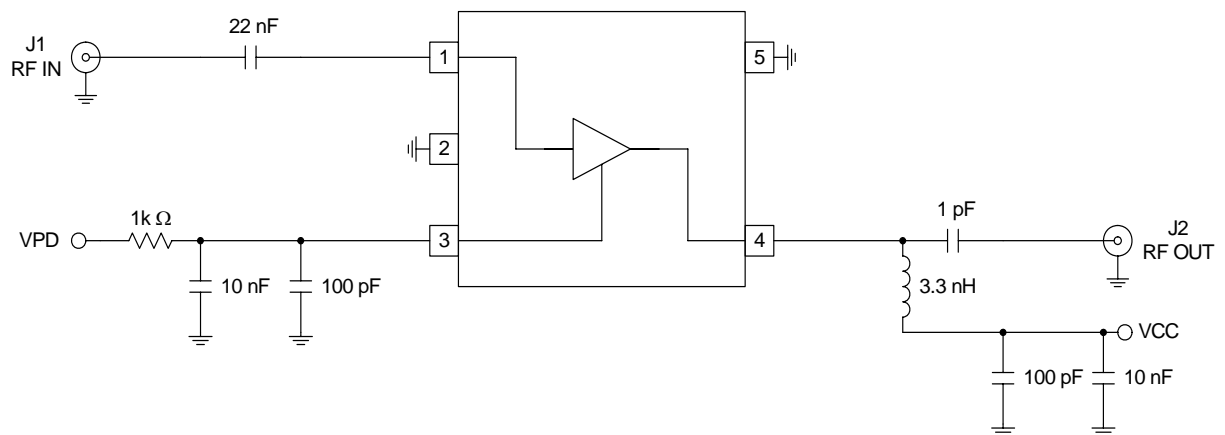
# RF2878

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. For best performance, keep traces physically short and connect immediately to ground plane.	
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 <math>V_{PD}</math> voltage.</p> <p>For driver amplifier applications, this is the Power Down pin for the IC. <math>V_{PD}=2.8V \pm 0.1V</math> is required for proper operation. <math>V_{PD}&lt;0.9V</math> 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 <math>V_{PD}=2.8V</math> is 2.0mA typical and 3.0mA Max (@ <math>V_{PD}=2.9V</math>).</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. For best performance, keep traces physically short and connect immediately to ground plane.	

## Application Schematic: Low Noise Amplifier ~881MHz Operation

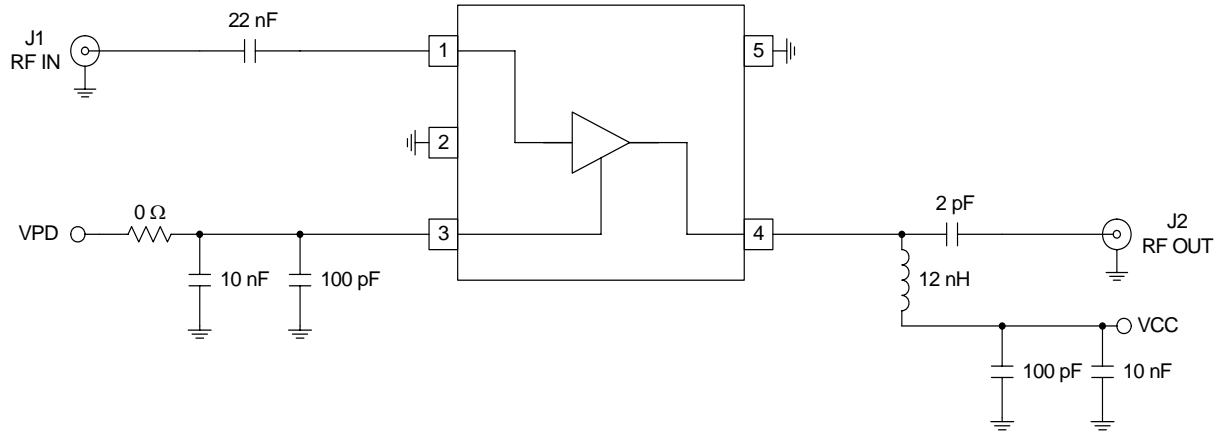


## Application Schematic: Low Noise Amplifier ~1950MHz Operation

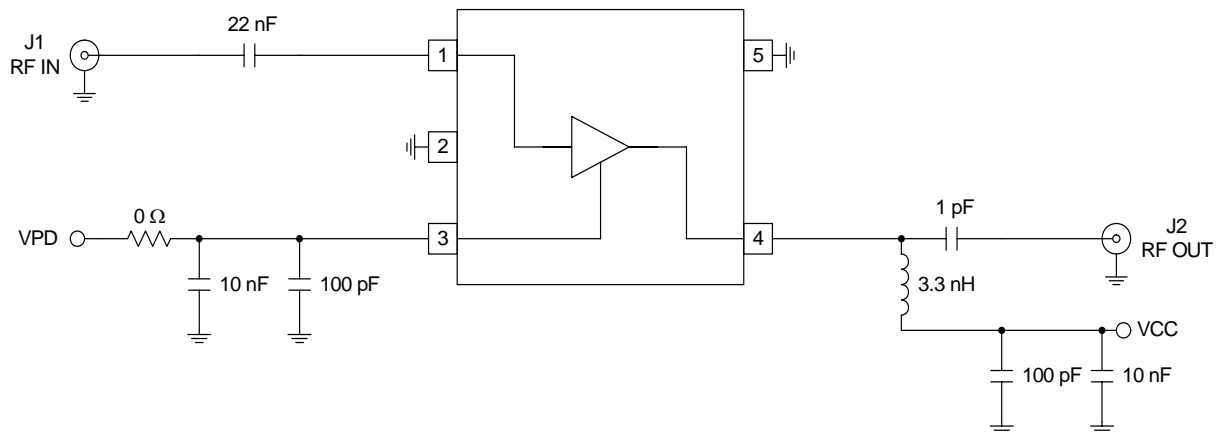


# RF2878

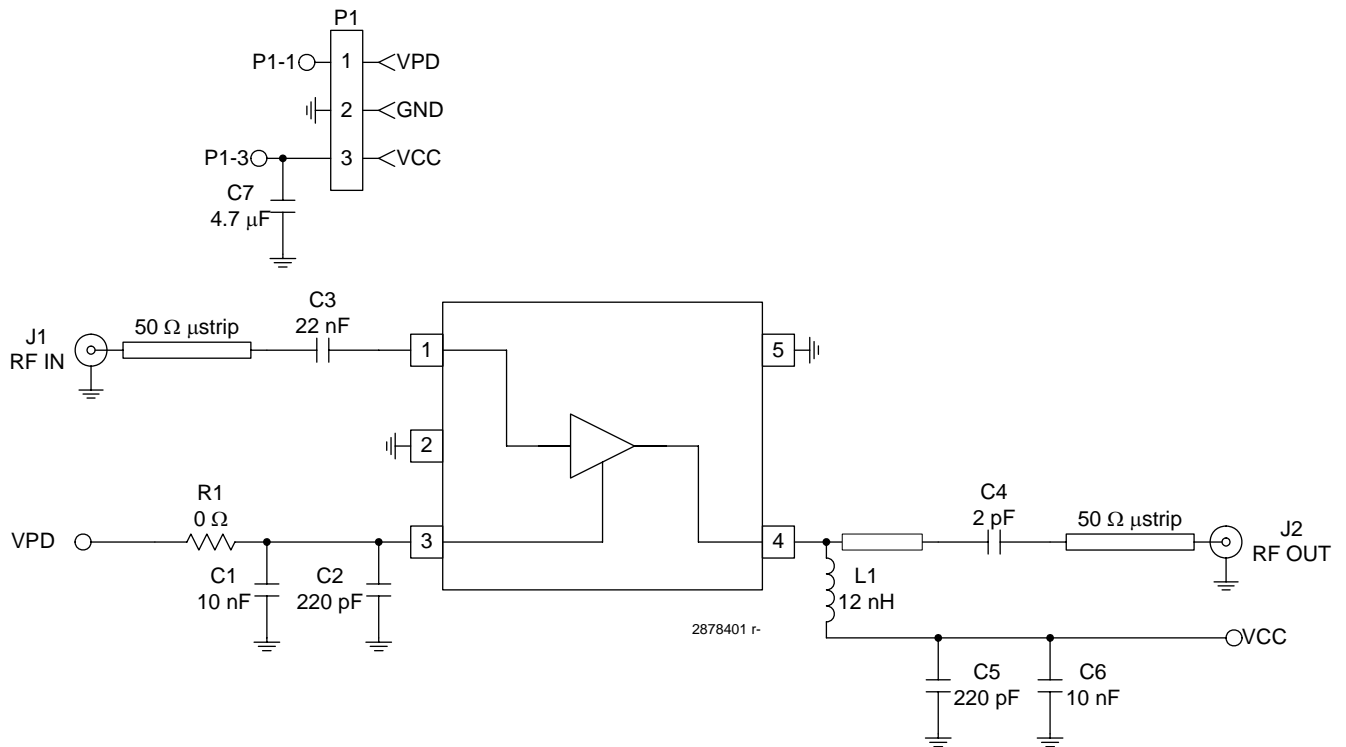
## Application Schematic: Driver Amplifier ~836MHz Operation



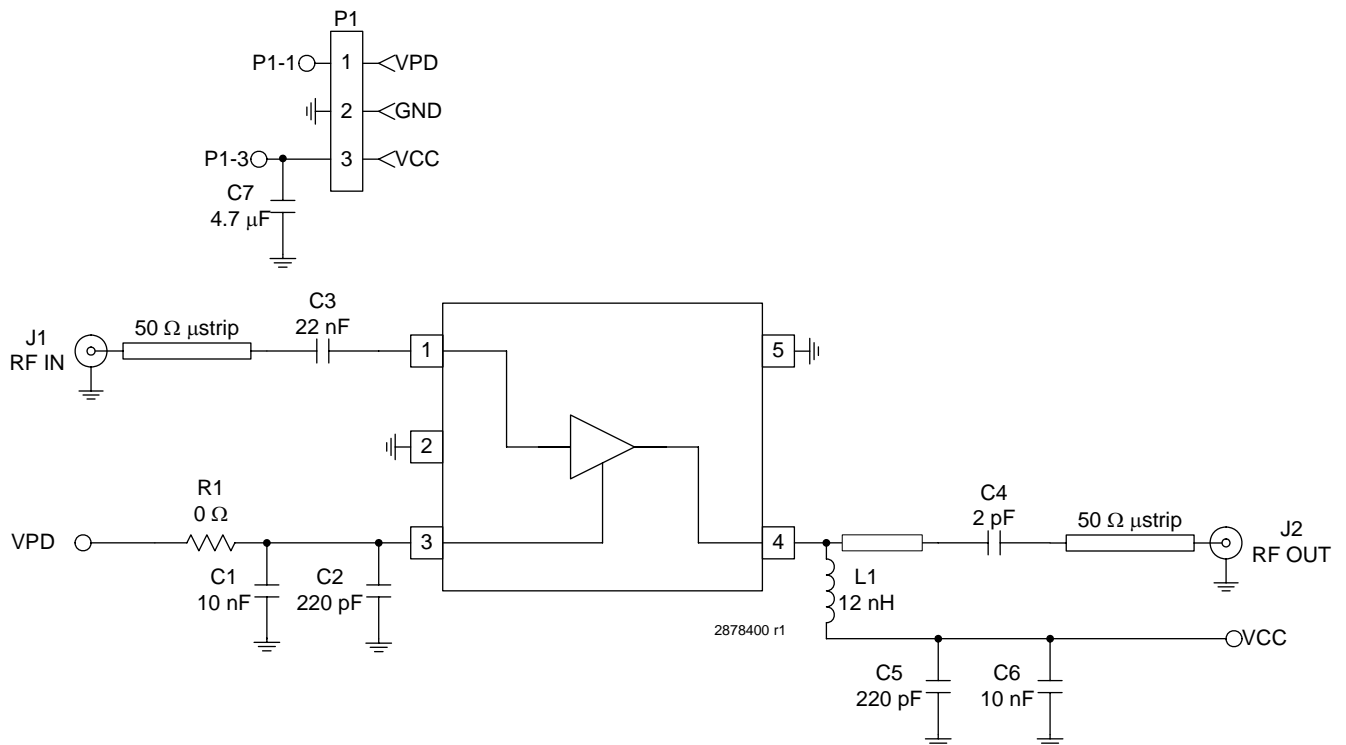
## Application Schematic: Driver Amplifier ~1880MHz Operation



## Evaluation Board Schematic: Low Noise Amplifier ~881MHz Operation

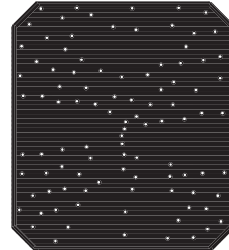
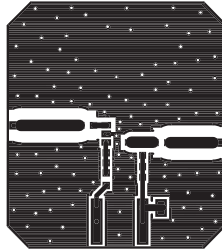
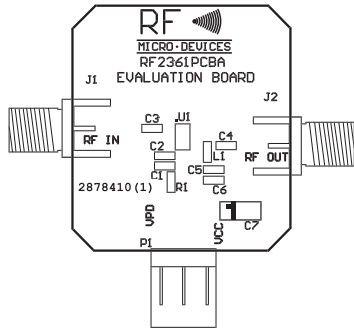


## Evaluation Board Schematic: Driver Amplifier ~836MHz Operation

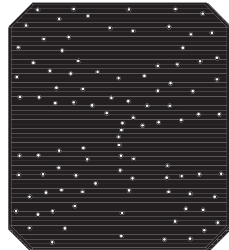
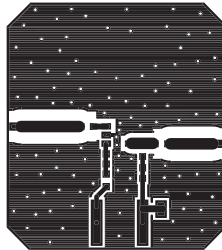
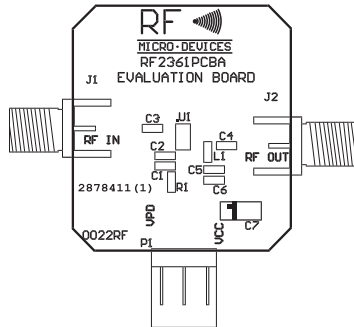


## Evaluation Board Layout - 900MHz Driver

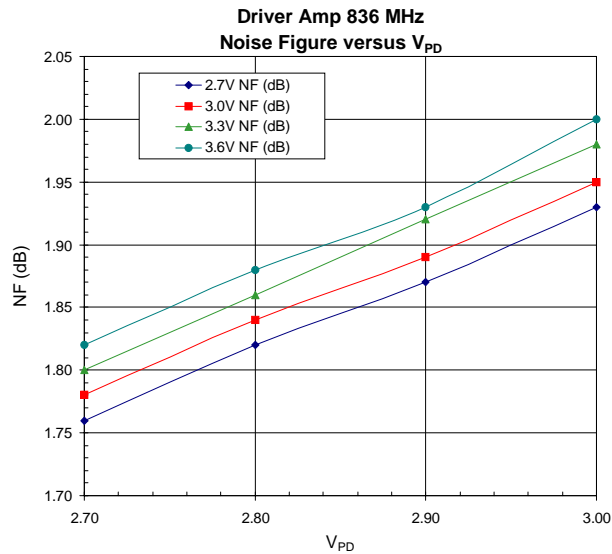
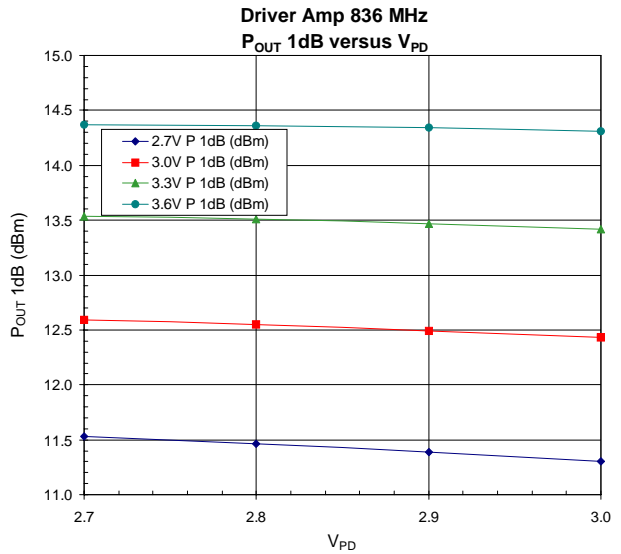
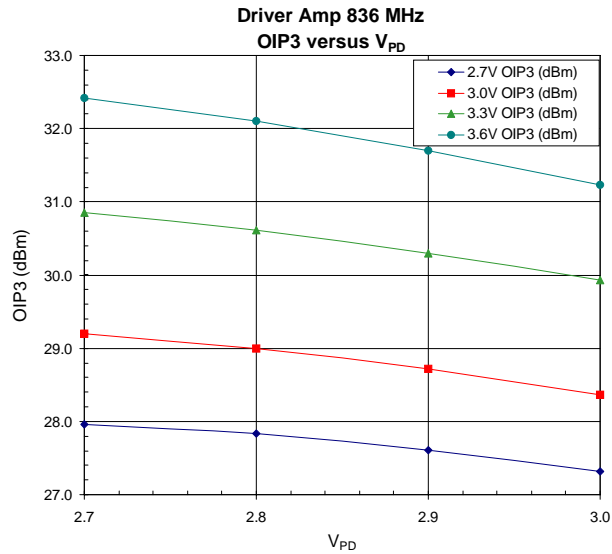
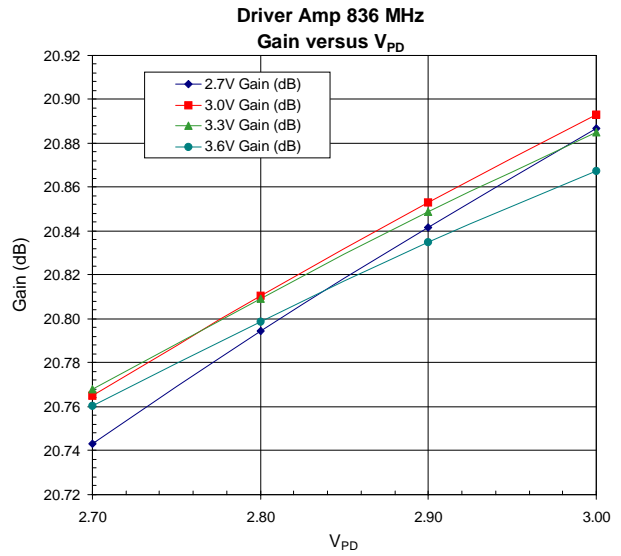
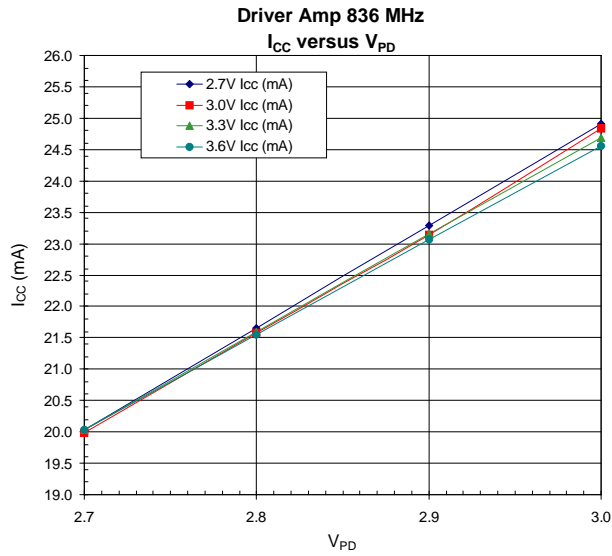
Board Size 0.948" x 1.063"  
Board Thickness 0.031"; Board Material FR-4



## Evaluation Board Layout - 900MHz LNA

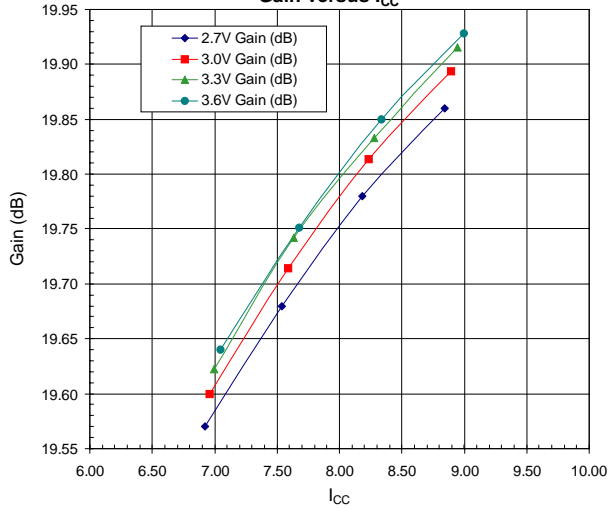






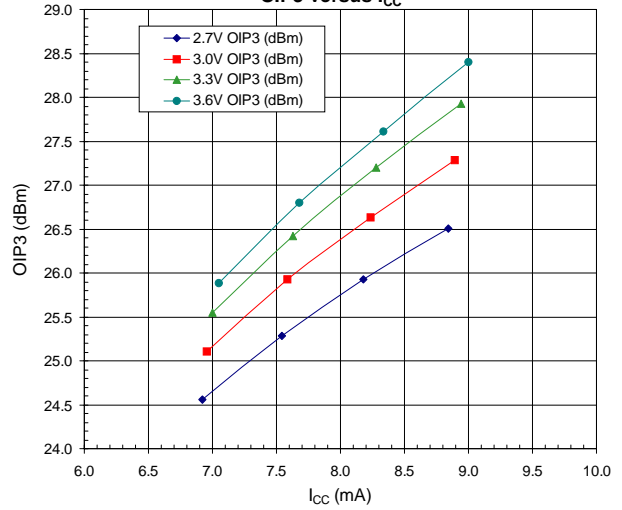
Low Noise Amplifier 881 MHz

Gain versus  $I_{CC}$



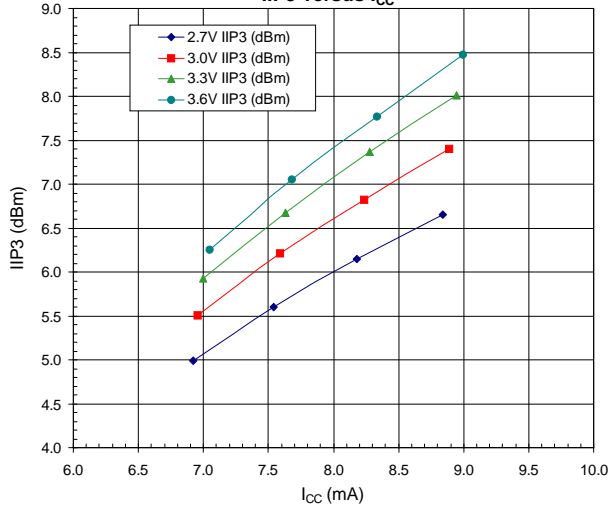
Low Noise Amplifier 881 MHz

OIP3 versus  $I_{CC}$



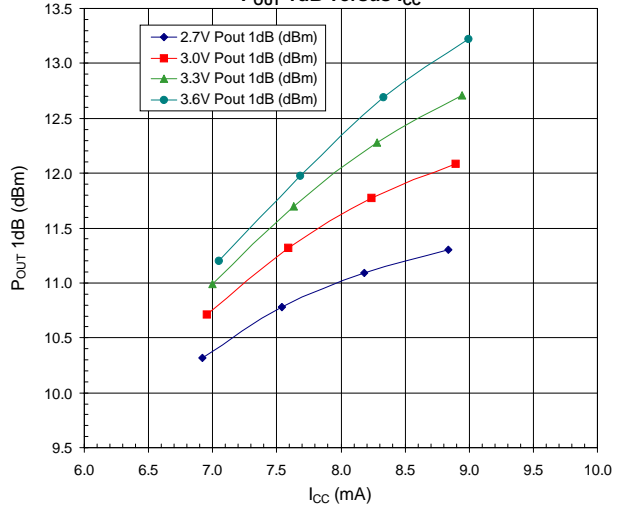
Low Noise Amplifier 881 MHz

IIP3 versus  $I_{CC}$



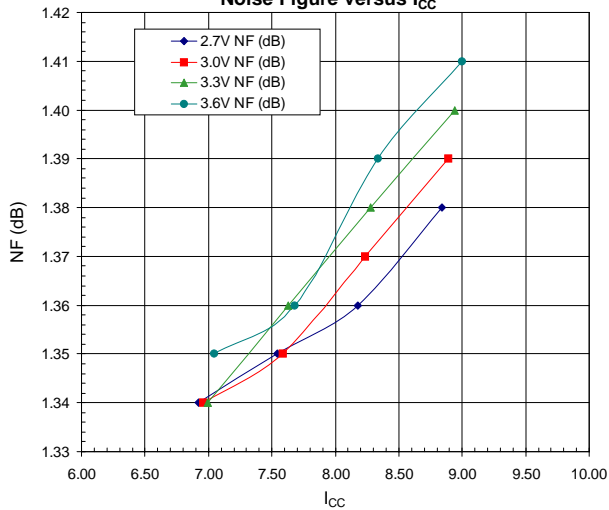
Low Noise Amplifier 881 MHz

$P_{OUT}$  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 for RFMD components are based on IPC-7351 standards and RFMD empirical data. The pad pattern shown has been developed and tested for optimized assembly at RFMD. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.

### PCB Metal Land Pattern

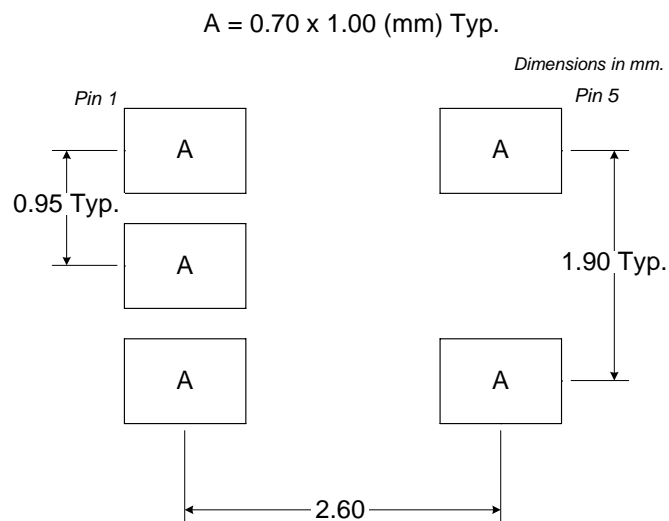


Figure 1. PCB Metal Land Pattern (Top View)

## 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.

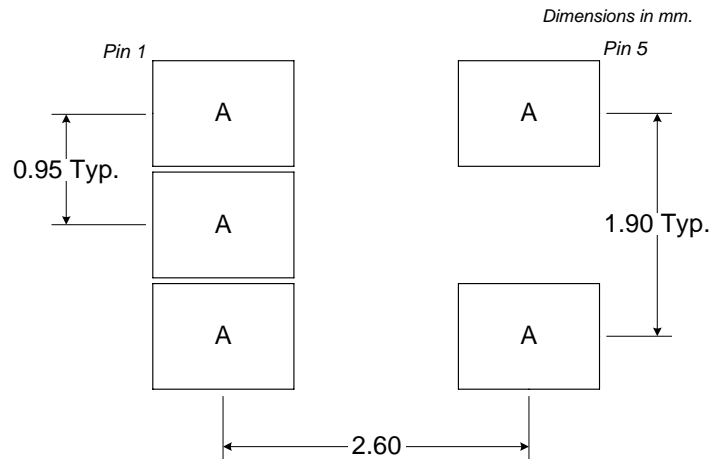


Figure 2. PCB Solder Mask (Top View)