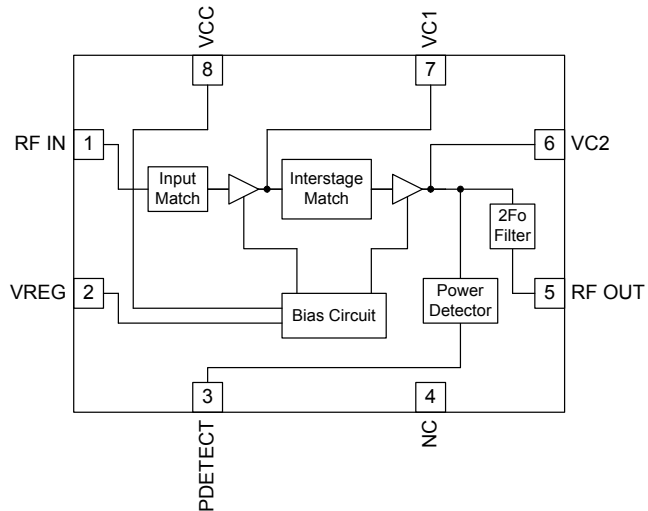


## Features

- Single Power Supply 3.0V to 4.2V
- 26dB Minimum Gain, Input Matched to 50Ω
- 2.4GHz to 2.5GHz Frequency Range
- 11g  $P_{OUT} = +17\text{ dBm} @ 3\% \text{ Typ EVM, } 125\text{ mA}$

## Applications

- IEEE802.11b/g/n WLAN Applications
- 2.5GHz ISM Band Applications
- Commercial and Consumer Systems
- Portable Battery-Powered Equipment
- Spread-Spectrum and MMDS Systems



Functional Block Diagram

## Product Description

The RF5222 is a linear, medium-power, high-efficiency, two-stage amplifier IC designed specifically for battery-powered WLAN applications such as PC cards, mini PCI, and compact flash applications. The device is manufactured on an advanced InGaP Gallium Arsenide Heterojunction Bipolar Transistor (HBT) process, and has been designed for use as the final RF amplifier in 2.5GHz OFDM and other spread-spectrum transmitters. The device is provided in a 2.2mmx2.2mm, 8-pin, QFN with a backside ground. The RF5222 is designed to maintain linearity over a wide range of supply voltage and power output. The RF5222 also has built-in power detector and incorporates the input and interstage matching components internally which reduces the component count used externally and makes it easier to incorporate on any design.

## Ordering Information

RF5222	3.0V to 4.2V, 2.4GHz to 2.5GHz Linear Power Amplifier
RF5222PCK-410	Fully assembled evaluation board tuned for 2.4 to 2.5 GHz and 5 piece loose samples

## Optimum Technology Matching® Applied

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

## Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.5 to +4.2	V <sub>DC</sub>
Power Control Voltage (V <sub>REG</sub> )	-0.5 to +3.2	V
DC Supply Current	240	mA
Input RF Power	+10	dBm
Operating Ambient Temperature	-30 to +85	°C
Storage Temperature	-40 to +150	°C
Moisture sensitivity	JEDEC Level 2	
ESD Human Body Model (HBM)	500	V
Machince Model (MM)	125	V

**Caution!** ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

RoHS status based on EUDirective2002/95/EC (at time of this document revision).

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>IEEE802.11g</b>					Temperature = +25 °C, V <sub>CC</sub> = 3.3V, V <sub>REG</sub> = 3.1V pulsed at 1% to 100% duty cycle, Frequency = 2450MHz, circuit per evaluation board schematic, unless otherwise specified
<b>Frequency</b>	2.4		2.5	GHz	IEEE802.11g IEEE802.11n
Output Power		17		dBm	At max data rate, OFDM modulation RMS, mean, V <sub>CC</sub> = 3.3V modified output match
EVM*		3.0	4.0	%	RMS, mean
Gain	26	31		dB	At +17 dBm RF P <sub>OUT</sub> and 54 Mbps
Gain Variance Over Temperature			1.5	±dB	-30 °C to +85 °C, 2.4GHz to 2.5GHz
Power Detector					
P <sub>OUT</sub> = 8 dBm		0.36		V	
P <sub>OUT</sub> = 17 dBm		0.9		V	
Power Supply	3.0	3.3	4.2	V <sub>DC</sub>	
V <sub>REG</sub> Input Voltage	3.0	3.1	3.2	V <sub>DC</sub>	Operating
Output VSWR			10:1		The PA is stable, no spurs above -43 dBm
Input Return Loss		-15	-10	dB	
Turn-on Time**		0.5	1.8	μS	Output stable to within 90% of final gain
Second Harmonic			-43	dBm	Fundamental frequency is between 2.4GHz and 2.5GHz; RFP <sub>OUT</sub> = +17 dBm
<b>Current Consumption</b>					
Quiescent Current		85		mA	Data rate @ ≤ 3.5% EVM RMS, mean
Operating Current		125		mA	P <sub>OUT</sub> = +17 dBm, V <sub>CC</sub> = 3.3V, diff. output match required
I <sub>REG</sub> Current		3.5	6	mA	V <sub>CC</sub> = +3.3V <sub>DC</sub>
Shutdown Current		8	10	μA	

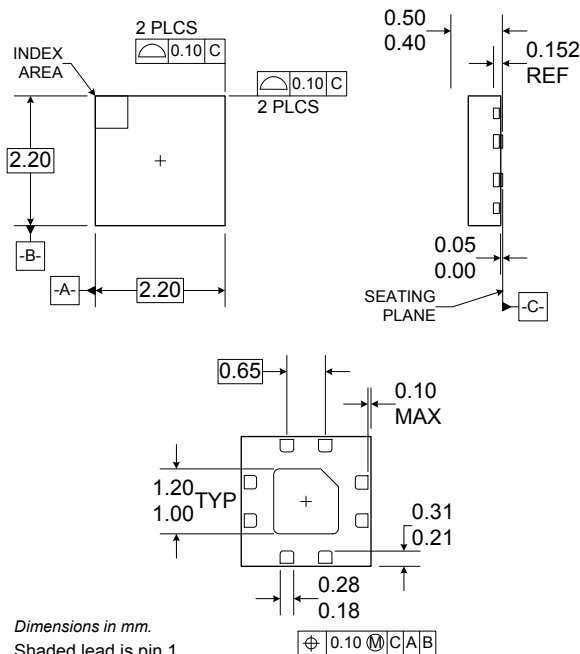
Notes:

\*The EVM specification is obtained with a signal generator that has an EVM floor of less than 0.7%.

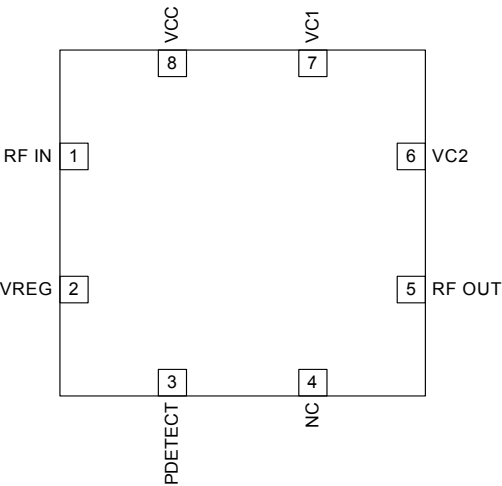
\*\*The PA must operate with gated bias voltage input at 1% to 99% duty cycles without any EVM or other parameter degradation.

Pin	Function	Description
1	RF IN	RF input. Input is matched to 50Ω and DC block is provided internally.
2	VREG	Bias current control voltage for the first and second amplifier stage.
3	PDETECT or NC	Power detector which provides an output voltage proportional to the RF output power level. May need external decoupling capacitor for P <sub>DETECT</sub> load sensitivity. May need external circuitry to bring output voltage to desired level. May be left unconnected if function is not desired.
4	NC	This pin may be left unconnected or may be connected to ground.
5	RF OUT	RF output. A DC blocking capacitor may be needed as this pin of the PA is a DC short to ground.
6	VC2	Voltage supply for second stage amplifier. External low frequency bypass capacitors should be connected if no other low frequency decoupling is employed.
7	VC1	Voltage supply for the first amplifier stage. External low frequency bypass capacitors should be connected if no other low frequency decoupling is employed.
8	VCC	Supply voltage for the bias reference and control circuit. May be connected with V <sub>C1</sub> and V <sub>C2</sub> (with a single supply voltage). The 56pF bypass capacitor should be placed as close as possible to the IC for the best performance.
Pkg Base	GND	The center metal base of the QFN package provides DC and RF ground as well as heat sink for the amplifier.

## Package Drawing



Pin Out



## Theory of Operation and Application Information

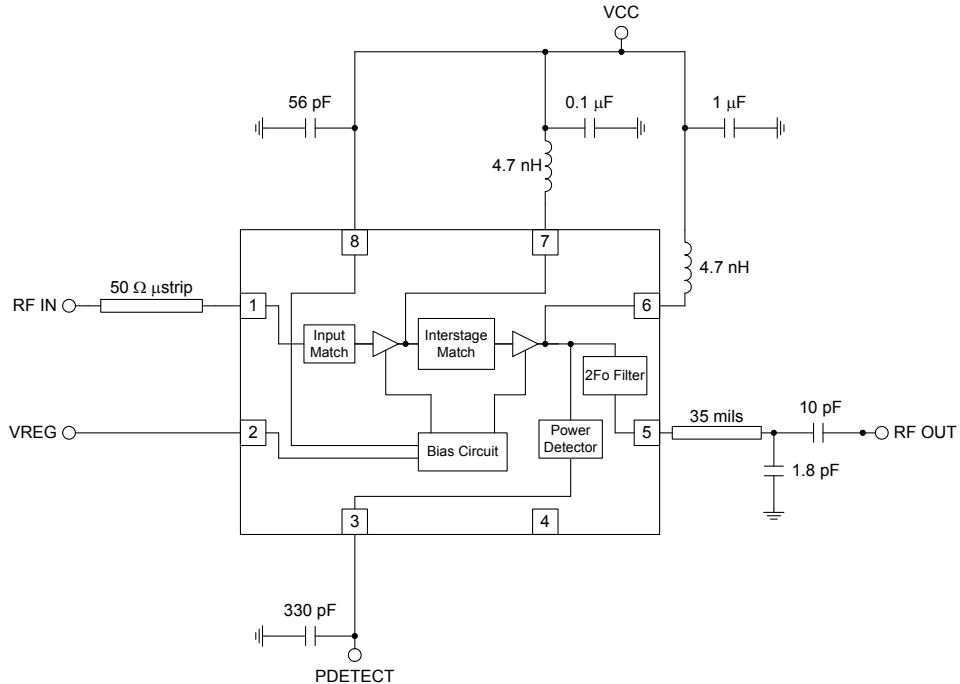
The RF5222 is a two-stage power amplifier (PA) with a minimum gain of 26dB in the 2.4GHz to 2.5GHz ISM band. The RF5222 has integrated input and interstage matching components thus allowing minimal bill of material (BOM) parts count in end applications. The RF5222 is designed primarily for IEEE802.11b/g/n WLAN applications where the available supply voltage and current are limited. This amplifier will operate to (and below) the lowest expected voltage made available by a typical PCMCIA slot in a laptop PC, and will maintain required linearity at decreased supply voltages. The device is provided in a 2.2mmx2.2mmx0.45mm, 8-pin, QFN with backside ground.

The RF5222 requires only a single positive supply of 3.3V nominal to operate to full specifications. Power control is provided through one bias voltage pin ( $V_{REG}$ ). The input DC blocking cap is provided internally and the evaluation board circuit (available from RFMD, Inc. (RFMD)) is optimized for 3.3V<sub>DC</sub> applications. For best performance, it is important to duplicate (as closely as possible) the layout of the evaluation board. The RF5222 has primarily been characterized with a voltage on  $V_{REG}$  of 3.1V<sub>DC</sub>. If you prefer to use a bias voltage that is significantly different than 3.1V<sub>DC</sub>, or a different frequency than the recommended frequency range, contact RFMD Sales or Application Engineering for additional data and guidance.

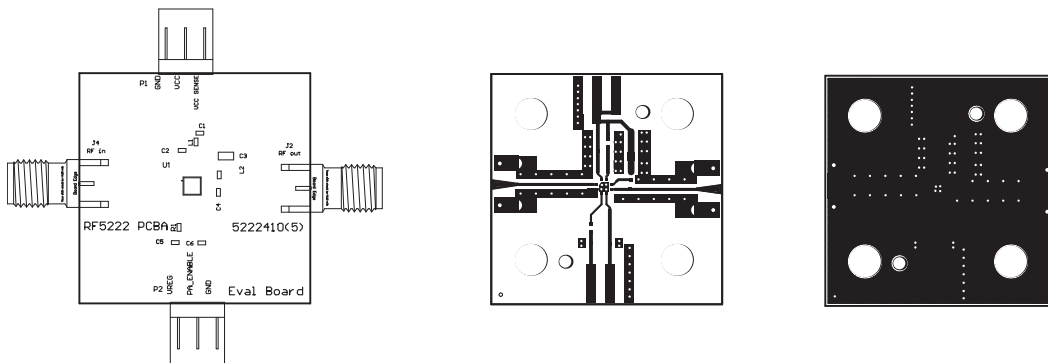
There is no required matching on the RF5222 input or interstage circuits. Only the RF5222 output stage requires matching allowing the RF5222 to be implemented in applications requiring the fewest end product bill of materials (BOM) parts count and lowest BOM cost. In most cases, the capacitor used as part of the RF5222 output matching circuit is also employed to accomplish DC-blocking. The RF5222PCBA evaluation board (available from RF Micro Devices, Inc. (RFMD)) is optimized for 3.3V<sub>DC</sub> supply input.

For best results, the PA circuit layout from the evaluation board should be copied as closely as possible, particularly the ground layout and ground vias. Other configurations may also work, but the design process is much easier and quicker if the layout is copied from the RF5222 evaluation board. Gerber files of RFMD PCBA designs can be provided on request. The RF5222 is a very easy part to implement, but care in circuit layout and component selection is always advisable when designing circuits to operate at 2.5GHz. The RF5222 evaluation board layout and schematic are available using 0201 (US) size components which will help shrink the overall size of the total area of the PA and components of the intended design. Please contact RFMD Sales or Application Engineering for additional data and guidance.

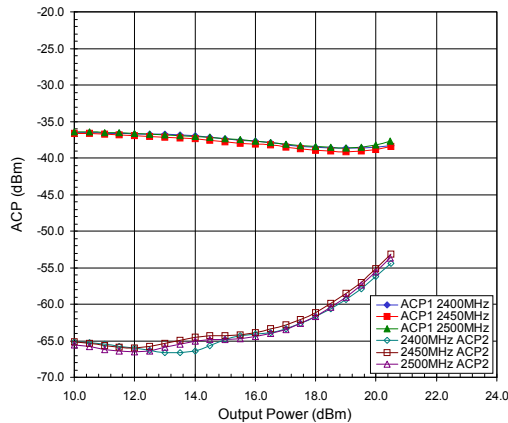
## Application Schematic



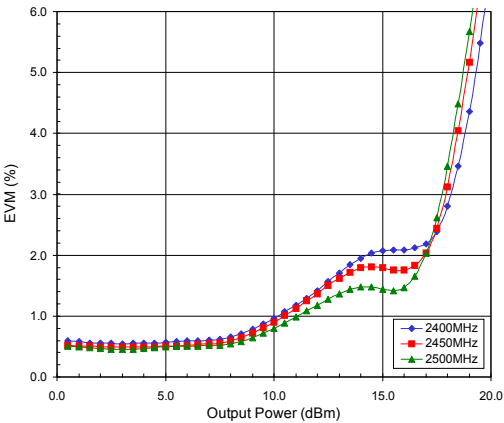
**Evaluation Board Layout**  
**Board Size 1.2" x 1.2"**  
**Board Thickness 0.032", Board Material FR-4**



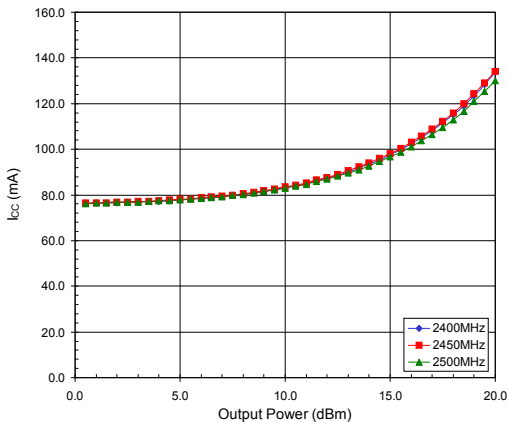
ACP versus  $P_{OUT}$



EVM versus  $P_{OUT}$



Operating Current versus  $P_{OUT}$



$P_{DETECT}$  versus  $P_{OUT}$

