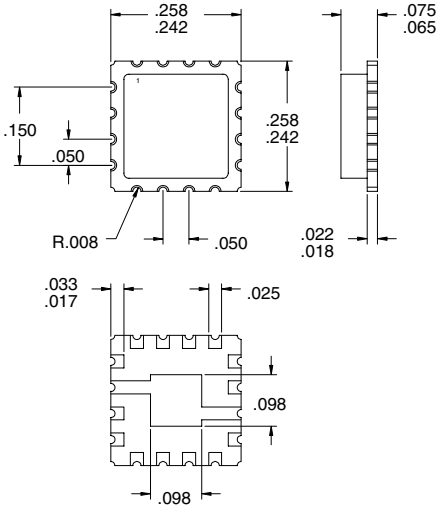
HIGH POWER UHF AMPLIFIER

Typical Applications

- Analog Communication Systems
- Analog Cellular Systems (AMPS & TACS)
- 900MHz Spread Spectrum Systems
- 400MHz Industrial Radios
- Driver Stage for Higher Power Applications
- Portable Battery Powered Equipment

Product Description

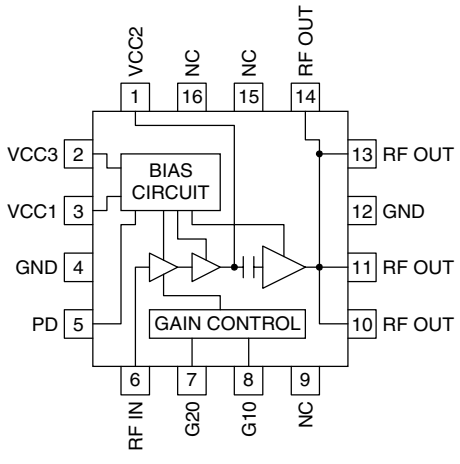
The RF2115L is a high power amplifier IC. The device is manufactured on an advanced Gallium Arsenide Heterojunction Bipolar Transistor (HBT) process, and has been designed for use as the final RF amplifier in analog cellular phone transmitters or ISM applications operating at 915MHz. The device is packaged in a 16-lead ceramic quad leadless chip carrier with a backside ground. The device is self-contained with the exception of the output matching network and power supply feed line. A two-bit digital control provides 4 levels of power control, in 10dB steps.



Package Style: QLCC-16

Optimum Technology Matching® Applied

- ☐ Si BJT
- ☑ GaAs HBT
- ☐ GaAs MESFET
- ☐ Si Bi-CMOS
- ☐ SiGe HBT
- ☐ Si CMOS



Functional Block Diagram

Features

- Single 5V to 6.5V Supply
- Up to 1.0W CW Output Power
- 33dB Small Signal Gain
- 48% Efficiency
- Digitally Controlled Output Power
- Small Package Outline (0.25" x 0.25")

Ordering Information

RF2115L	High Power UHF Amplifier
RF2115L PCBA	Fully Assembled Evaluation Board

RF Micro Devices, Inc.
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Greensboro, NC 27409, USA
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http://www.rfmd.com

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage (V_{CC})	-0.5 to +8.5	V_{DC}
Power Down Voltage (V_{PD})	-0.5 to +5.0	V
Control Voltage (G10, G20)	-0.5 to +5.5	V
DC Supply Current	700	mA
Input RF Power	+12	dBm
Output Load	20:1	
Operating Case Temperature	-40 to +100	°C
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

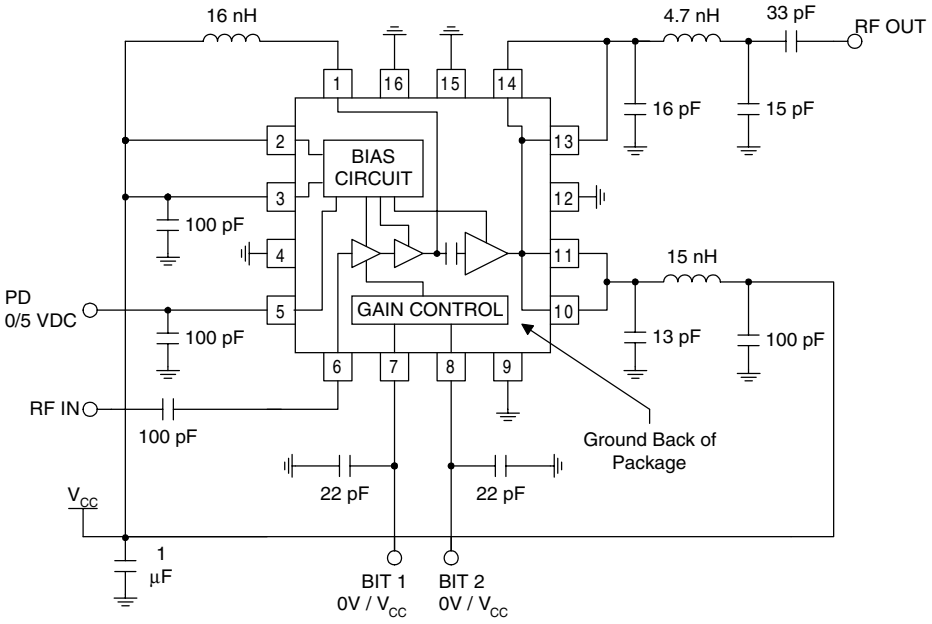
Caution! ESD sensitive device.

Parameter	Specification			Unit	Condition	
	Min.	Typ.	Max.			
Overall					T=25°C, V_{CC}=5.8V, V_{PD}=5.0V, Z_{LOAD}=9Ω, P_{IN}=0dBm, Freq=840MHz	
Frequency Range		430 to 930		MHz		
Maximum CW Output Power		+30.5		dBm	Note that increasing V_{CC} does not result in higher output power; power may actually decrease.	
		+30		dBm	V_{CC}=5.8V, Z_{LOAD}=12Ω	
		+29.5		dBm	V_{CC}=5.0V, Z_{LOAD}=9Ω	
		+28.5		dBm	V_{CC}=5.0V, Z_{LOAD}=12Ω	
Total CW Efficiency at Maximum Output	40	48		%		
Small-signal Gain		33		dB		
Second Harmonic		-23		dBc	Without external second harmonic trap	
Third Harmonic		-36		dBc		
Fourth Harmonic		-35		dBc		
Input VSWR		<2:1				
Input Impedance		50		Ω		
Power Control					G20	G10
Output Power	+30	+30.5	+36	dBm	1	1
	+17	+20	+23	dBm	1	0
	+7	+11	+13	dBm	0	1
	-4	+2.5	+6	dBm	0	0
Power Supply Current	350	415	600	mA	1	1
	75	125	175	mA	1	0
	35	56	90	mA	0	1
	21	38	50	mA	0	0
Idle Current	30	55	80	mA	1	1
Power Down "ON"		5.0		V	Voltage supplied to the input; Part is "ON"	
Power Down "OFF"	0		0.2	V	Voltage supplied to the input; Part is "OFF"	
Power Down Control						
Power Down "ON"		5.0		V	Voltage supplied to the input; Part is "ON"	
Power Down "OFF"	0		0.2	V	Voltage supplied to the input; Part is "OFF"	
Current Drain		1	10	µA	V_{PD} < 0.1 V_{DC}	

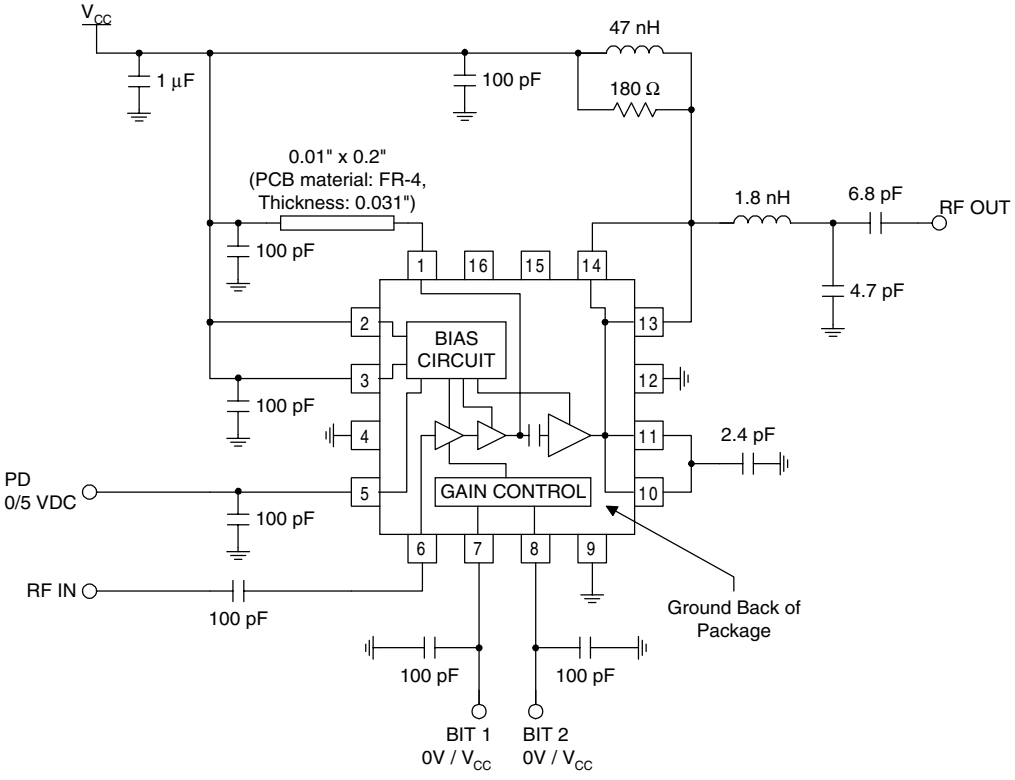
Pin	Function	Description	Interface Schematic
1	VCC2	Positive supply for the second stage (driver) amplifier. This is an unmatched transistor collector output. This pin should see an inductive path to AC ground (V_{CC} with a UHF bypassing capacitor). This inductance can be achieved with a short, thin microstrip line or with a low value chip inductor (approximately 2.7nH). At lower frequencies, the inductance value should be larger (longer microstrip line) and V_{CC} should be bypassed with a larger bypass capacitor (see the application schematic for 430MHz operation). This inductance forms a matching network with the internal series capacitor between the second and third stages, setting the amplifier's frequency of maximum gain. An additional 1μF bypass capacitor in parallel with the UHF bypass capacitor is also recommended, but placement of this component is not as critical. In most applications, pins 1, 2, and 3 can share a single 1μF bypass capacitor.	
2	VCC3	Positive supply for the active bias circuits. This pin can be externally combined with pin 3 (VCC1) and the pair bypassed with a single UHF capacitor, placed as close as possible to the package. Additional bypassing of 1μF is also recommended, but proximity to the package is not as critical. In most applications, pins 1, 2, and 3 can share a single 1μF bypass capacitor.	
3	VCC1	Positive supply for the first stage (input) amplifier. This pin can be externally combined with pin 2 (VCC3) and the pair bypassed with a single UHF capacitor, placed as close as possible to the package. Additional bypassing of 1μF is also recommended, but proximity to the package is not as critical. In most applications, pins 1, 2, and 3 can share a single 1μF bypass capacitor. This pin can also be used for coarse analog gain control, even though it is not optimized for this function.	
4	GND	Ground connection. Keep traces physically short and connect immediately to ground plane for best performance. In addition, for specified performance, the package's backside metal should be soldered to ground plane.	
5	PD	Power down control voltage. When this pin is at 0V, the device will be in power down mode, dissipating minimum DC power. When this pin is at 5V the device will be in full power mode delivering maximum available gain and output power capability. This pin may also be used to perform some degree of gain control or power control when set to voltages between 0V and 5V. It is not optimized for this function so the transfer function is not linear over a wide range as with other devices specifically designed for analog gain control; however, it may be usable for coarse adjustment or in some closed loop AGC systems. This pin should not, in any circumstance, be higher in voltage than V_{CC}, nor should it ever be higher than 6.5V. This pin should also have an external UHF bypassing capacitor.	
6	RF IN	Amplifier RF input. This is a 50Ω RF input port to the amplifier. It does not contain internal DC blocking and therefore should be externally DC blocked before connecting to any device which has DC present or which contains a DC path to ground. A series UHF capacitor is recommended for the DC blocking.	
7	G20	RF output power gain control MSB (see specification table for logic). The control voltage at this pin should never exceed V_{CC}. This pin should also have an external UHF bypassing capacitor.	
8	G10	RF output power gain control LSB (see specification table for logic). The control voltage at this pin should never exceed V_{CC}. This pin should also have an external UHF bypassing capacitor.	
9	NC	Not internally connected.	

Pin	Function	Description	Interface Schematic
10	RF OUT	Amplifier RF output. This is an unmatched collector output of the final amplifier transistor. It is internally connected to pins 10, 11, 13, and 14 to provide low series inductance and flexibility in output matching. Bias for the final power amplifier output transistor must also be provided through two of these four pins. Typically, pins 10 and 11 are connected to a network that creates a second harmonic trap. For 830MHz operation, this network is simply a single 2.4pF capacitor from both pins to ground. This capacitor series resonates with internal bond wires at two times the operating frequency, effectively shorting out the second harmonic. Shorting out this harmonic serves to increase the amplifier's maximum output power and efficiency, as well as to lower the level of the second harmonic output. Typically, pins 13 and 14 are externally connected very close to the package and used as the RF output with a matching network that presents the optimum load impedance to the PA for maximum power and efficiency, as well as providing DC blocking at the output. An additional network of a bias inductor and parallel resistor provides DC bias and helps to protect the output from high voltage swings due to severe load mismatches. Shunt protection diodes are included to clip peak voltage excursions above approximately 15V to prevent voltage breakdown in worst case conditions.	
11	RF OUT	Same as pin 10.	
12	GND	Same as pin 4.	
13	RF OUT	Same as pin 10.	
14	RF OUT	Same as pin 10.	
15	NC	Not internally connected.	
16	NC	Not internally connected.	
Pkg Base	GND	This contact is the main ground contact for the entire device. Care should be taken to ensure that this contact is well soldered in order to prevent performance from being degraded from that indicated in the specifications.	

Application Schematic
430MHz

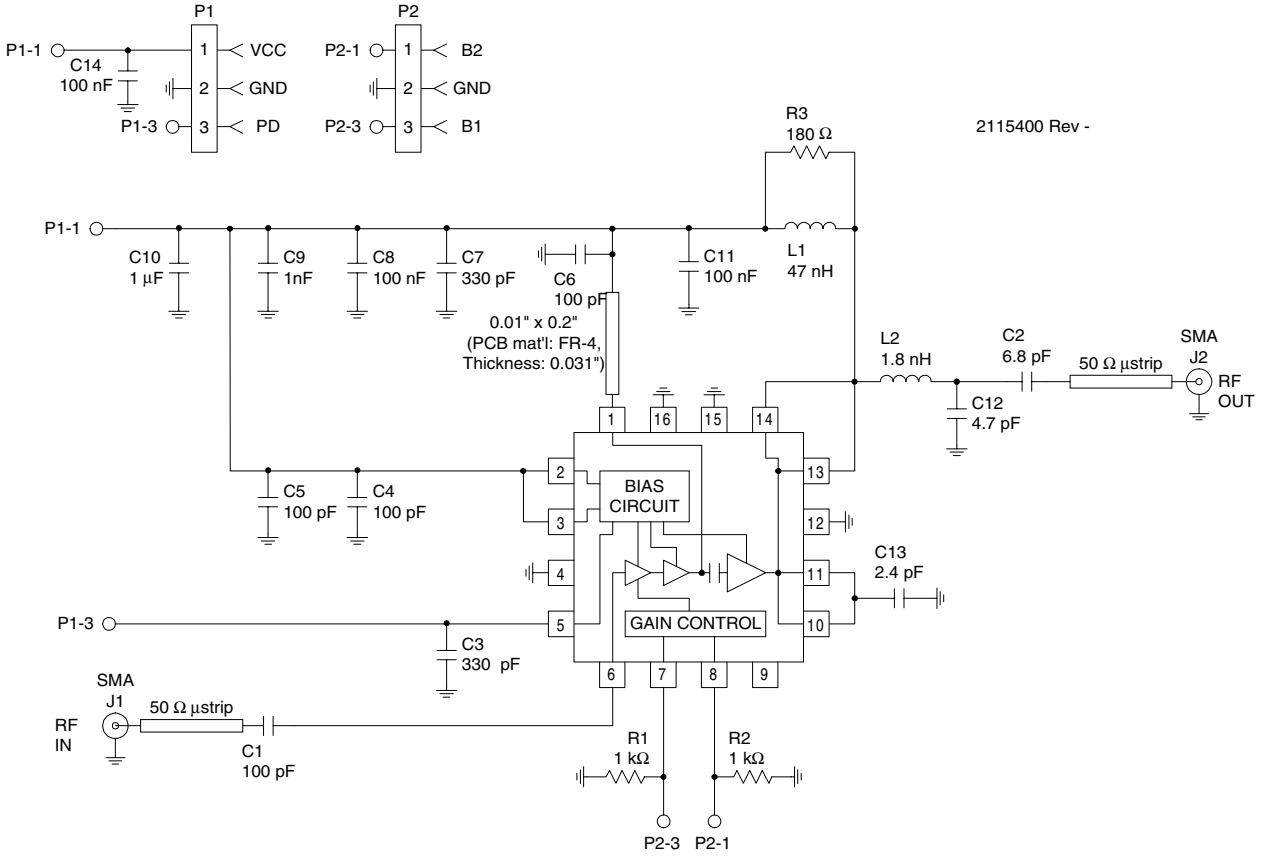


Application Schematic
840MHz



Evaluation Board Schematic
840MHz Operation

(Download Bill of Materials from www.rfmd.com.)



Evaluation Board Layout
2” x 3”