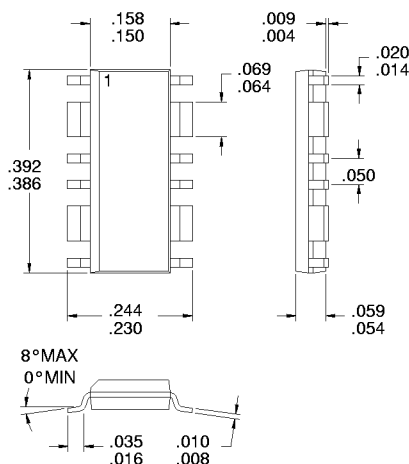


**Typical Applications**

- 915MHz ISM Band Applications
- Driver stage for GSM Base Stations
- Base Station Equipment
- Commercial and Consumer Systems
- Portable Battery Powered Equipment

**Product Description**

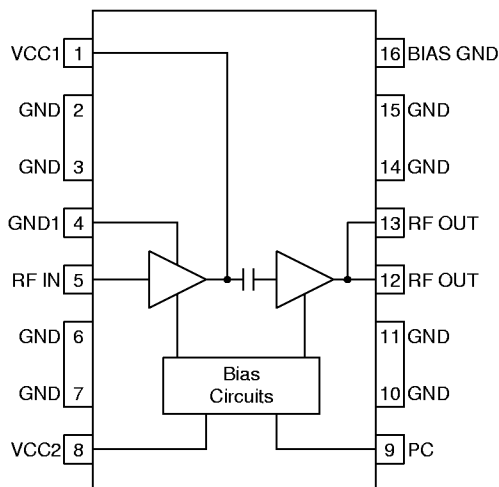
The RF2123 is a high power, high efficiency amplifier IC. The device is manufactured on an advanced Gallium Arsenide Heterojunction Bipolar Transistor (HBT) process, and has been designed for use as a driver stage for GSM base stations, for the 915MHz ISM band, as the final PA for Micro and Pico base stations, and in other applications in the 800MHz to 950MHz band. On-board power control provides over 45dB of control range with an analog voltage input, and provides power down with a logic "low" for standby operation. The device is self-contained with 50Ω input and the output can be easily matched to obtain optimum power and efficiency characteristics.



**Optimum Technology Matching® Applied**

- Si BJT       GaAs HBT       GaAs MESFET  
 Si Bi-CMOS

**Package Style: SOP-16 QBW1**



**Functional Block Diagram**

**Features**

- Single Supply Voltage
- +33dBm Output Power
- 30dB Gain with Analog Gain Control
- 880MHz to 915MHz Operation
- Supports GSM , E-GSM, 915MHz ISM

**Ordering Information**

- RF2123                      High Power Amplifier  
 RF2123 PCBA              Fully Assembled Evaluation Board

RF Micro Devices, Inc.  
 7625 Thorndike Road  
 Greensboro, NC 27409, USA

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<http://www.rfmd.com>

## Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.5 to +7.5	V <sub>DC</sub>
Power Control Voltage (V <sub>PC</sub> )	-0.5 to +5	V
DC Supply Current	1100	mA
Input RF Power	+12	dBm
Output Load VSWR	10:1	
Ambient Operating Temperature	-30 to +90	°C
Storage Temperature	-40 to +150	°C



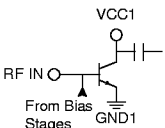
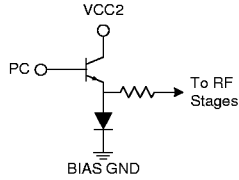
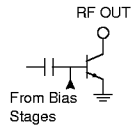
**Caution!** ESD sensitive device.

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).

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POWER AMPLIFIERS

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>Overall</b>					T=25 °C, V <sub>CC</sub> =5.8V, V <sub>PC</sub> =4.0V, P <sub>IN</sub> =+6dBm, Freq=890MHz to 915MHz,
Operating Frequency Range		880 to 915		MHz	
Usable Frequency Range		800 to 950		MHz	
Maximum Output Power	+33			dBm	
	+32			dBm	T=+90 °C, V <sub>CC</sub> =5.3V, V <sub>PC</sub> =4.0V At maximum output power
Total Efficiency		TBD		%	
Input Power for Max Output		+6	+8	dBm	
Output Noise Power in Receive Band		TBD		dBm/Hz	Any gain setting
Isolation		-35		dB	In "OFF" state, P <sub>IN</sub> =+6dBm
Second Harmonic		-40	-35	dBc	
Third Harmonic		-45	-35	dBc	
Input Impedance		50		Ω	
Input VSWR		<2.5:1			
Output Load VSWR	10:1				Spurious<-60dBc
<b>Power Control</b>					
Power Control "ON"		3.6	4.0	V	Voltage supplied to the input
Power Control "OFF"	0.2	0.5		V	Voltage supplied to the input
Power Control Range		65		dB	
Turn On/Off Time			100	ns	
<b>Power Supply</b>					
Power Supply Voltage	4.3	5.8	7.5	V	Specifications
				V	Operating limits
Power Supply Current		1		A	DC Current at maximum output power
			10	μA	V <sub>PC</sub> =0.5V

Pin	Function	Description	Interface Schematic
1	VCC1	Power supply for the driver stage and interstage matching. This pin forms the shunt inductance needed for proper tuning of the interstage match. Please refer to the application schematic for proper configuration, and note that position and value of the components are important.	
2	GND	Ground connection for final power stage. Keep traces physically short and connect immediately to the ground plane for best performance. This pin is also connected internally to pins 6, 7, 10, 11, 14, and 15 for a very low inductance and low thermal resistance path to ground.	
3	GND	Same as pin 2.	
4	GND1	Ground connection for the driver stage. Keep traces physically short and connect immediately to the ground plane for best performance. It is recommended to use separate vias to the ground plane for this return path to maintain stability.	See pin 1 schematic.
5	RF IN	RF Input. This is a 50Ω input, but the actual impedance depends on the interstage matching network connected to pin 3. An external DC blocking capacitor is required if this port is connected to a DC path to ground or a DC voltage.	See pin 1 schematic.
6	GND	Same as pin 2.	
7	GND	Same as pin 2.	
8	VCC2	Power supply for the bias circuits.	See pin 9 schematic.
9	PC	Power Control. When this pin is "low," all circuits are shut off. A "low" is typically 0.5V or less at room temperature. A shunt bypass capacitor is required. During normal operation this pin is the power control. Control range varies from about 2V for 0dBm to 3.6V for +35dBm RF output power. The maximum power that can be achieved depends on the actual output matching; see the application information for more details.	
10	GND	Same as pin 2.	
11	GND	Same as pin 2.	
12	RF OUT	RF Output and power supply for the output stage. Bias voltage for the final stage is provided through this wide output pin. An external matching network is required to provide the optimum load impedance.	
13	RF OUT	Same as pin 12.	See pin 12 schematic.
14	GND	Same as pin 2.	
15	GND	Same as pin 2.	
16	BIAS GND	Bias return for the reference diode.	See pin 9 schematic.

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## Theory of Operation and Application Information

The RF2123 is a two-stage device with 30 dB gain at full power. Therefore, the drive required to fully saturate the output is +6dBm. Based upon HBT (Heterojunction Bipolar Transistor) technology, the part requires only a single positive 6V supply to operate to full specification. Bias control is provided through a single pin interface, and the final stage ground is achieved through the four large pins on both sides of the package. First stage ground is brought out through a separate ground pin for isolation from the output. These grounds should be connected directly with vias to the PCB ground plane. The output is brought out through the wide output pin, and forms the RF output signal path.

The amplifier operates in near Class C bias mode. The final stage is "deep AB", meaning the quiescent current is very low. As the RF drive is increased, the final stage self-biases, causing the bias point to shift up and, at full power, draws about 900mA. The optimum load for the output stage is approximately  $5\Omega$ . This is the load at the output collector, and is created by the series inductance formed by the output bond wires, leads, and microstrip, and 2 shunt capacitors external to the part. With this match, a  $50\Omega$  terminal impedance is achieved. The input is internally matched to  $50\Omega$  with just a blocking capacitor needed. This data sheet defines the configuration for GSM operation.

The input is DC coupled; thus, a blocking cap must be inserted in series. Also, the first stage bias may be adjusted by a resistive divider with high value resistors on this pin to  $V_{PC}$  and ground. For nominal operation, however, no external adjustment is necessary as internal resistors set the bias point optimally.

$V_{CC1}$  provides supply voltage to the first stage, as well as provides some frequency selectivity to tune to the operating band. Essentially, the bias is fed to this pin through a short microstrip. A bypass capacitor sets the inductance seen by the part, so placement of the bypass cap can affect the frequency of the gain peak. This supply should be bypassed individually with 100pF capacitors before being combined with  $V_{CC}$  for the output stage to prevent feedback and oscillations.

The RF OUT pin provides the output power. Bias for the final stage is fed to this output line, and the feed must be capable of supporting the approximately 1A of current required. Care should be taken to keep the losses low in the bias feed and output components. A narrow microstrip line is recommended because DC

losses in a bias choke will degrade efficiency and power.

The part will operate over a 4.3V to 7.5V range. Under nominal conditions, the power at 5.3V will be greater than +32dBm at +90°C. As the voltage is increased, however, the output power will increase. Thus, in a system design, the ALC (Automatic Level Control) Loop will back down the power to the desired level. This must occur during operation, or the device may be damaged from too much power dissipation. At 7.5V, over +35.5dBm may be produced; however, this level of power is not recommended for this package.

The HBT breakdown voltage is  $>20V$ , so nominally at 6V there should be no issue with overvoltage. Under extreme conditions, however, which can occur in a cellular handset environment, the supply voltage could be much higher. These conditions may correspond to operation in a battery charger, especially with the battery removed, which "unloads" the supply circuit. To add to this worst-case scenario, the RF drive may be at full power during transmit, and the output VSWR could be extremely high, corresponding to a broken or removed antenna. Under all of the above conditions, the peak RF voltages could well exceed two times the supply voltage, forcing the device into breakdown. The RF2123 includes overvoltage protection diodes at the output, which begin clipping the waveform peaks at approximately 15V. This protects the device's output from breaking down under these worst-case conditions, and provides a rugged, robust component for the system designer. For optimum reliability, it is recommended that the supply voltage to the part under operation be limited to 7.5V.

High current conditions are also potentially dangerous to any RF device. High currents lead to high channel temperatures and may force early failures. The RF2123 includes temperature compensation circuits in the bias network to stabilize the RF transistors, thus limiting the current through the amplifier and protecting the devices from damage. The same mechanism works to compensate the currents due to ambient temperature variations.