#### **GENERAL PURPOSE AMPLIFIER**

RoHS Compliant & Pb-Free Product Package Style: QFN, 12-Pin, 3 x 3

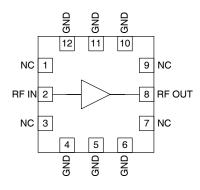


#### **Features**

- DC to >6000MHz Operation
- Internally Matched Input and Output
- 13.2dB Small Signal Gain
- +28.7 dBm Output IP3
- +16.0dBm Output P1dB
- Footprint Compatible with Micro-X

#### **Applications**

- Basestation Applications
- Broadband, Low-Noise Gain Blocks
- IF or RF Buffer Amplifiers
- Driver Stage for Power Amplifiers
- Final PA for Low-Power Applications
- High Reliability Applications



**Functional Block Diagram** 

#### **Product Description**

The RF3395 is a general purpose, low-cost RF amplifier IC. The device is manufactured on an advanced Gallium Arsenide Heterojunction Bipolar Transistor (HBT) process, and has been designed for use as an easily-cascadable  $50\Omega$  gain block. Applications include IF and RF amplification in wireless voice and data communication products operating in frequency bands up to  $6000\,\text{MHz}$ . The device is self-contained with  $50\Omega$  input and output impedances and requires only two external DC-biasing elements to operate as specified. The device is designed for cost effective high reliability in a plastic package. The  $3\,\text{mmx}3\,\text{mm}$  footprint is compatible with standard ceramic and plastic Micro-X packages.

#### **Ordering Information**

RF3395 General Purpose Amplifier
RF3395PCBA-41X Fully Assembled Evaluation Board

#### **Optimum Technology Matching® Applied**

☑ GaAs HBT	☐ SiGe BiCMOS	☐ GaAs pHEMT	☐ GaN HEMT
☐ GaAs MESFET	☐ Si BiCMOS	Si CMOS	
☐ InGaP HBT	☐ SiGe HBT	☐ Si BJT	

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#### **Absolute Maximum Ratings**

Parameter	Rating	Unit
Input RF Power	+13	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-60 to +150	°C
Icc	80	mA



#### 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 EU Directive 2002/95/EC (at time of this document revision).

The information in this publication is believed to be accurate and reliable. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents, or other rights of third parties, resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.

Parameter	Specification		Unit	Condition	
raiailletei	Min.	Тур.	Max.	Ullit	Condition
Overall					T=25 °C, I <sub>CC</sub> =65 mA (See Note 1.)
Frequency Range		DC to >6000		MHz	
3dB Bandwidth		6		GHz	
Gain	12.5	13.5		dB	Freq=500MHz
	12.5	13.5		dB	Freq=850MHz
	12.2	13.2		dB	Freq=2000MHz
	11.7	12.7		dB	Freq=3000MHz
	11.4	12.4			Freq=4000MHz
	10.0	11.0			Freq=6000MHz
Noise Figure		4.5		dB	Freq=2000MHz
Input VSWR		1.9:1			In a $50\Omega$ system, DC to $6000  \text{MHz}$
Output VSWR		2.0:1			In a $50\Omega$ system, DC to $500 MHz$
		1.7:1			In a $50\Omega$ system, $500$ MHz to $6000$ MHz
Output IP <sub>3</sub>	+30.0	+34.5		dBm	Freq=850MHz
	+25.7	+28.7		dBm	Freq=2000MHz
Output P <sub>1dB</sub>	+17.0	+18.6		dBm	Freq=850MHz
	+14.5	+16.0		dBm	Freq=2000MHz
Reverse Isolation		-18.0		dB	Freq=2000MHz
Thermal					I <sub>CC</sub> =65mA, P <sub>DISS</sub> =313mW. (See Note 3.)
Theta <sub>JC</sub>		221		°C/W	V <sub>PIN</sub> =4.81V
Maximum Measured Junction Temperature at DC Bias Condi- tions		154		°C	T <sub>AMB</sub> =+85°C
Mean Time to Failures		465		years	T <sub>AMB</sub> =+85 °C
Power Supply					With $22\Omega$ bias resistor, T=+25°C
Device Operating Voltage	5.0	5.18	5.3	V	At pin 8 with I <sub>CC</sub> =65 mA
	6.2	6.6	7.0	V	At Evaluation Board Connector I <sub>CC</sub> =65mA
Operating Current		65	80	mA	See Note 2.

Note 1: All specification and characterization data has been gathered on standard FR-4 evaluation boards. These evaluation boards are not optimized for frequencies above 2.5 GHz. Performance above 2.5 GHz may improve if a high performance PCB is used.

Note 2: The RF3395 must be operated at or below 80 mA in order to achieve the thermal performance listed above. While the RF3395 may be operated at higher bias currents, 65 mA is the recommended bias to ensure the highest possible reliability and electrical performance.

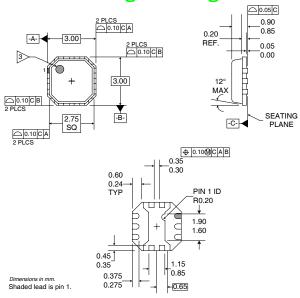
Note 3: Because of process variations from part to part, the current resulting from a fixed bias voltage will vary. As a result, caution should be used in designing fixed voltage bias circuits to ensure the worst case bias current does not exceed 80 mA over all intended operating conditions.



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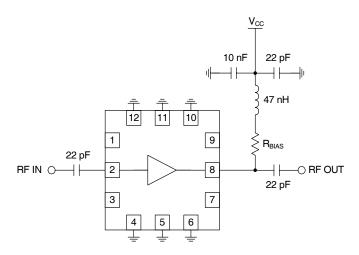
Pin	Function	Description	Interface Schematic
1	NC	No internal connections. It is not necessary to ground this pin.	
2	RF IN	RF input pin. This pin is NOT internally DC blocked. A DC blocking capacitor, suitable for the frequency of operation, should be used in most applications. DC coupling of the input is not allowed, because this will override the internal feedback loop and cause temperature instability.	
3	NC	No internal connections. It is not necessary to ground this pin.	
4	GND	Ground connection.	
5	GND	Ground connection.	
6	GND	Ground connection.	
7	NC	No internal connections. It is not necessary to ground this pin.	
ω	RF OUT	RF output and bias pin. Biasing is accomplished with an external series resistor and choke inductor to $V_{CC}$ . The resistor is selected to set the DC current into this pin to a desired level. The resistor value is determined by the following equation: $R = \frac{(V_{SUPPLY} - V_{DEVICE})}{I_{CC}}$ Care should also be taken in the resistor selection to <b>ensure that the current into the part never exceeds 80mA over the planned operating temperature.</b> This means that a resistor between the supply and this pin is always required, even if a supply near 5.0V is available, to provide DC feedback to prevent thermal runaway. Because DC is present on this pin, a DC blocking capacitor, suitable for the frequency of operation, should be used in most applications. The supply side of the bias network should also be well bypassed.	RF IN O
9	NC	No internal connections. It is not necessary to ground this pin.	
10	GND	Ground connection.	
11	GND	Ground connection.	
12	GND	Ground connection.	
Die Flag	GND	Ground connection. To ensure best performance, avoid placing ground vias directly beneath the part.	

### **Package Drawing**



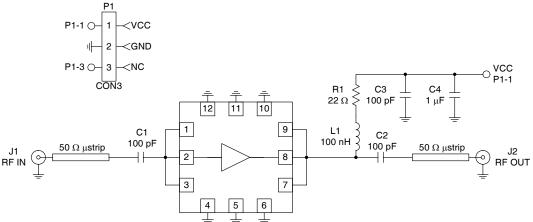


### **Application Schematic**



### **Evaluation Board Schematic**

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



#### NOTE:

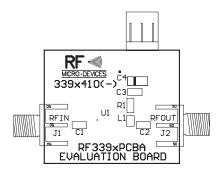
Evaluation board optimized for frequencies above 300 MHz and below 2.5 GHz. For operation below 300 MHz the value of inductor L1 and capcitors C1 and C2 should be increased.

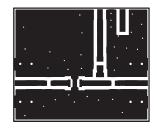


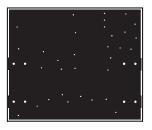
# **Evaluation Board Layout Board Size 1.195" x 1.000"**

### **Board Thickness 0.033", Board Material FR-4**

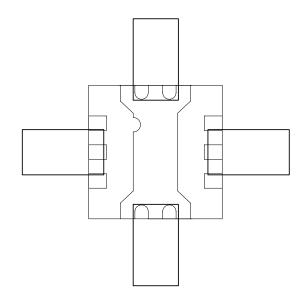
Note: A small amount of ground inductance is required to achieve datasheet performance. The necessary inductance may be generated by ensuring that no ground vias are placed directly below the footprint of the part.



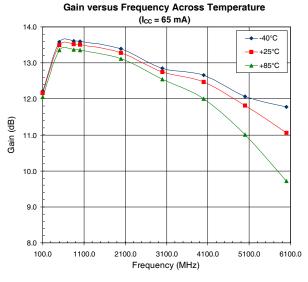


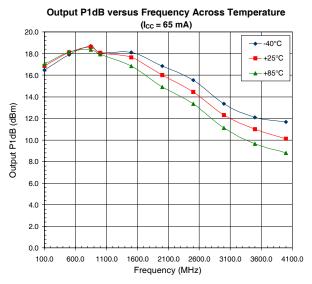


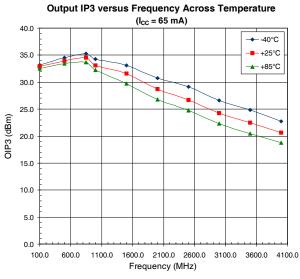
### Overlay of Suggested Micro-X and 3mmx3mm Layouts Showing Compatibility

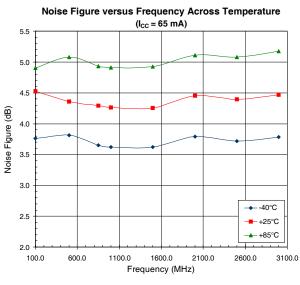


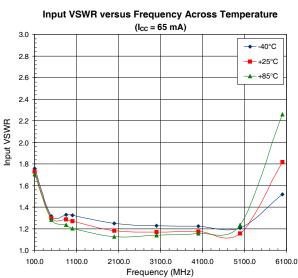


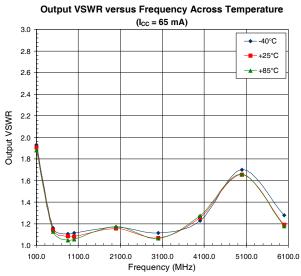




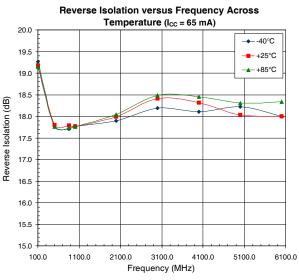


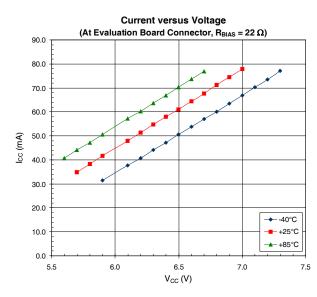


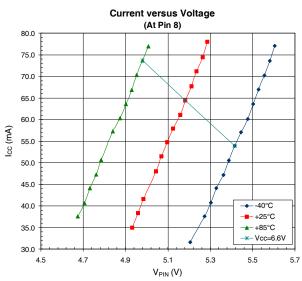


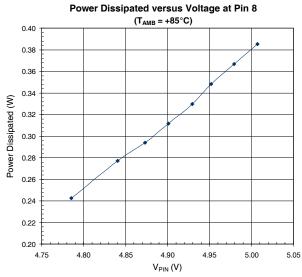


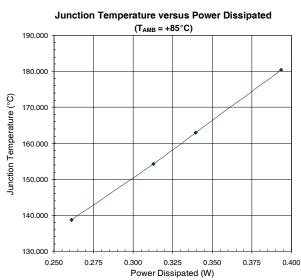














### **PCB Design Requirements**

#### **PCB Surface Finish**

The PCB surface finish used for RFMD's qualification process is Electroless Nickel, immersion Gold. Typical thickness is  $3\mu$ inch to  $8\mu$ inch Gold over  $180\mu$ inch 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 Mask Pattern**

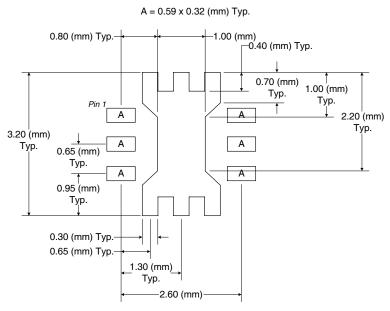


Figure 1. PCB Metal Land Pattern (Top View)



#### **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.

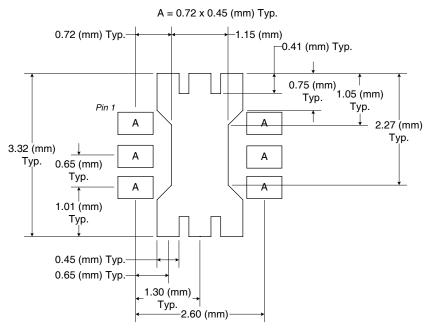


Figure 2. PCB Solder Mask (Top View)

#### Thermal Pad and Via Design

The PCB metal land pattern has been designed with a thermal pad that matches the exposed die paddle size on the bottom of the device.

Thermal vias are required in the PCB layout to effectively conduct heat away from the package. The via pattern has been designed to address thermal, power dissipation and electrical requirements of the device as well as accommodating routing strategies.

The via pattern used for the RFMD qualification is based on thru-hole vias with 0.203mm to 0.330mm finished hole size on a 0.5mm to 1.2mm grid pattern with 0.025mm plating on via walls. If micro vias are used in a design, it is suggested that the quantity of vias be increased by a 4:1 ratio to achieve similar results.

**NOTE:** A small amount of ground inductance is required to achieve data sheet performance. The necessary inductance may be generated by ensuring that no ground vias are placed directly below the footprint of the part.

