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MICROWAVE CORPORATION v02.0710



# HMC479ST89 / 479ST89E

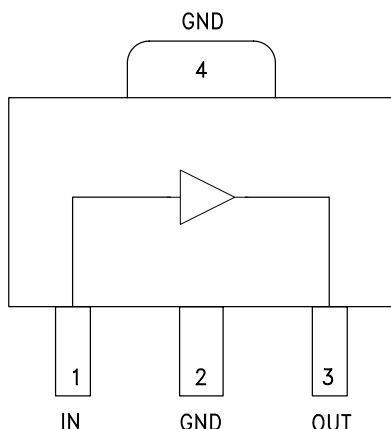
## SiGe HBT GAIN BLOCK MMIC AMPLIFIER, DC - 5 GHz

### Typical Applications

The HMC479ST89 / HMC479ST89E is an ideal RF/IF gain block & LO or PA driver:

- Cellular / PCS / 3G
- Fixed Wireless & WLAN
- CATV, Cable Modem & DBS
- Microwave Radio & Test Equipment

### Functional Diagram



### Features

- P1dB Output Power: +18 dBm
- Gain: 15 dB
- Output IP3: +33 dBm
- Cascadable 50 Ohm I/Os
- Single Supply: +5V to +12V
- Industry Standard SOT89 Package
- Included in the HMC-DK001 Designer's Kit

### General Description

The HMC479ST89 & HMC479ST89E are SiGe Heterojunction Bipolar Transistor (HBT) Gain Block MMIC SMT amplifiers covering DC to 5 GHz. Packaged in an industry standard SOT89, the amplifier can be used as a cascadable 50 Ohm RF/IF gain stage as well as a LO or PA driver with up to +20 dBm output power. The HMC479ST89 offers 15 dB of gain with a +33 dBm output IP3 at 850 MHz while requiring only 75 mA from a single positive supply. The Darlington feedback pair used results in reduced sensitivity to normal process variations and excellent gain stability over temperature while requiring a minimal number of external bias components.

### Electrical Specifications, $V_s = 8.0\text{ V}$ , $R_{bias} = 51\text{ Ohm}$ , $T_A = +25^\circ\text{ C}$

| Parameter                                                                   |               | Min. | Typ.  | Max.  | Units  |
|-----------------------------------------------------------------------------|---------------|------|-------|-------|--------|
| Gain                                                                        | DC - 1.0 GHz  | 12.5 | 15    |       | dB     |
|                                                                             | 1.0 - 2.0 GHz | 11.5 | 13.5  |       | dB     |
|                                                                             | 2.0 - 3.0 GHz | 10.5 | 12.5  |       | dB     |
|                                                                             | 3.0 - 4.0 GHz | 9.5  | 11.5  |       | dB     |
|                                                                             | 4.0 - 5.0 GHz | 8.5  | 10.5  |       | dB     |
| Gain Variation Over Temperature                                             | DC - 5 GHz    |      | 0.008 | 0.012 | dB/ °C |
| Input Return Loss                                                           | DC - 1.0 GHz  |      | 12    |       | dB     |
|                                                                             | 1.0 - 2.0 GHz |      | 16    |       | dB     |
|                                                                             | 2.0 - 4.0 GHz |      | 18    |       | dB     |
|                                                                             | 4.0 - 5.0 GHz |      | 22    |       | dB     |
| Output Return Loss                                                          | DC - 1.0 GHz  |      | 20    |       | dB     |
|                                                                             | 1.0 - 5.0 GHz |      | 22    |       | dB     |
| Reverse Isolation                                                           | DC - 5 GHz    |      | 18    |       | dB     |
| Output Power for 1 dB Compression (P1dB)                                    | 0.5 - 1.0 GHz | 15   | 18    |       | dBm    |
|                                                                             | 1.0 - 2.0 GHz | 13   | 16    |       | dBm    |
|                                                                             | 2.0 - 3.0 GHz | 11   | 14    |       | dBm    |
|                                                                             | 3.0 - 4.0 GHz | 10   | 13    |       | dBm    |
|                                                                             | 4.0 - 5.0 GHz | 8    | 11    |       | dBm    |
| Output Third Order Intercept (IP3)<br>(Pout= 0 dBm per tone, 1 MHz spacing) | 0.5 - 1.0 GHz |      | 33    |       | dBm    |
|                                                                             | 1.0 - 2.5 GHz |      | 30    |       | dBm    |
|                                                                             | 2.5 - 4.0 GHz |      | 25    |       | dBm    |
|                                                                             | 4.0 - 5.0 GHz |      | 23    |       | dBm    |
| Noise Figure                                                                | DC - 3.0 GHz  |      | 4.0   |       | dB     |
|                                                                             | 3.0 - 5.0 GHz |      | 4.5   |       | dB     |
| Supply Current (Icq)                                                        |               |      | 75    |       | mA     |

Note: Data taken with broadband bias tee on device output.

For price, delivery and to place orders: Hittite Microwave Corporation, 20 Alpha Road, Chelmsford, MA 01824

Phone: 978-250-3343 Fax: 978-250-3373 Order On-line at [www.hittite.com](http://www.hittite.com)

Application Support: Phone: 978-250-3343 or [apps@hittite.com](mailto:apps@hittite.com)



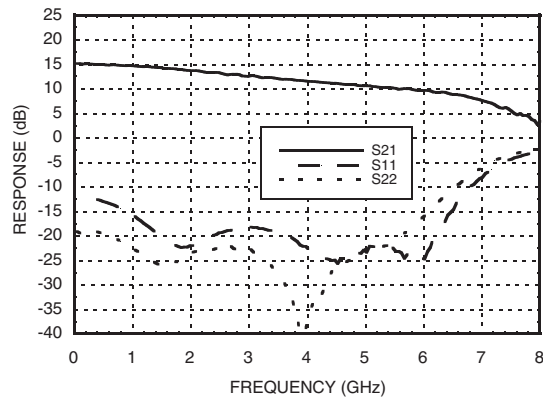
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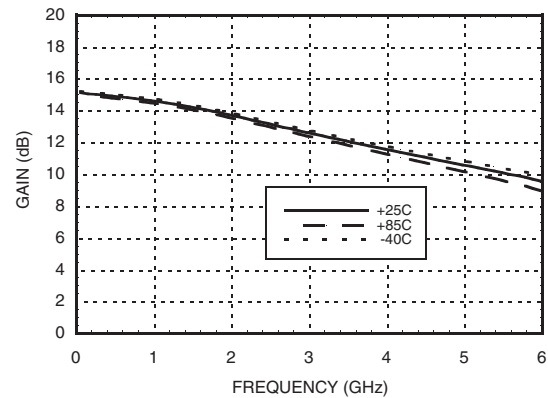
## HMC479ST89 / 479ST89E

**SiGe HBT GAIN BLOCK  
MMIC AMPLIFIER, DC - 5 GHz**

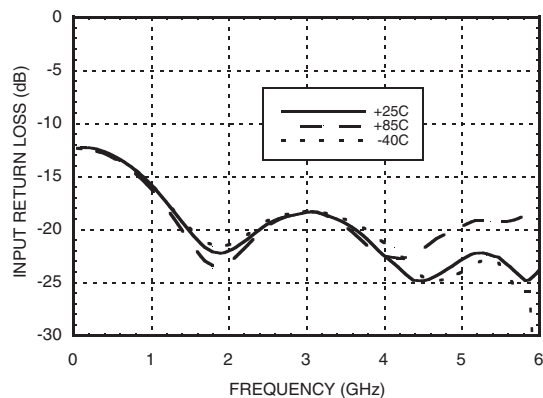
**Broadband Gain & Return Loss**



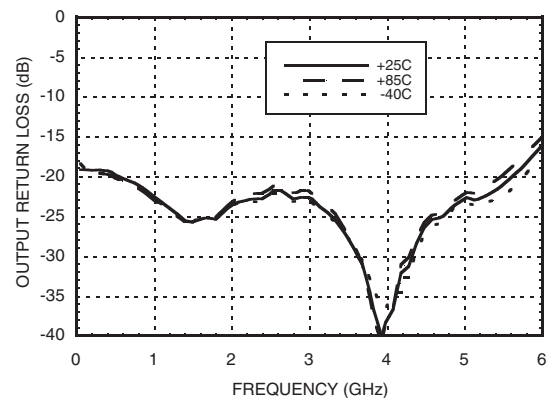
**Gain vs. Temperature**



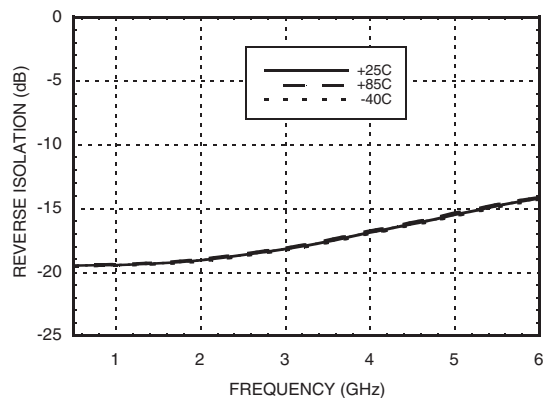
**Input Return Loss vs. Temperature**



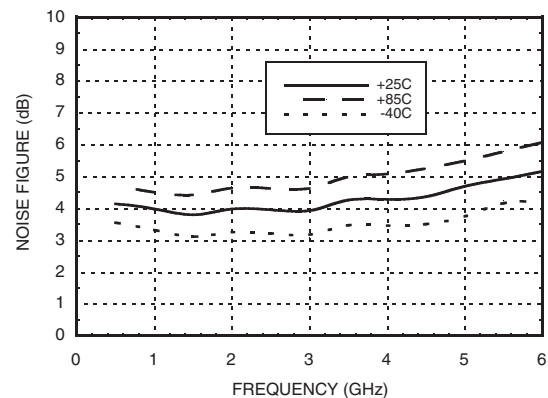
**Output Return Loss vs. Temperature**



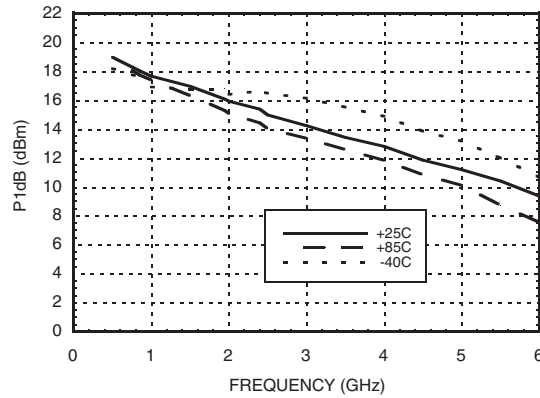
**Reverse Isolation vs. Temperature**



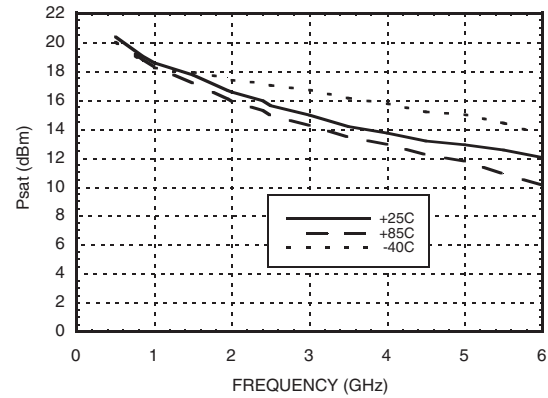
**Noise Figure vs. Temperature**



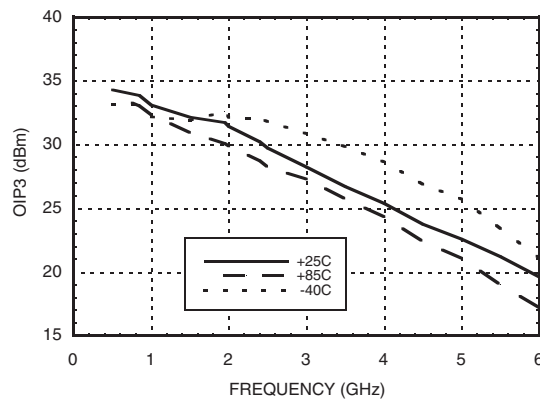
**P1dB vs. Temperature**



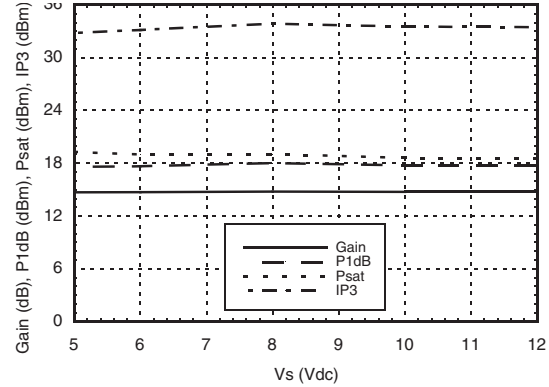
**Psat vs. Temperature**



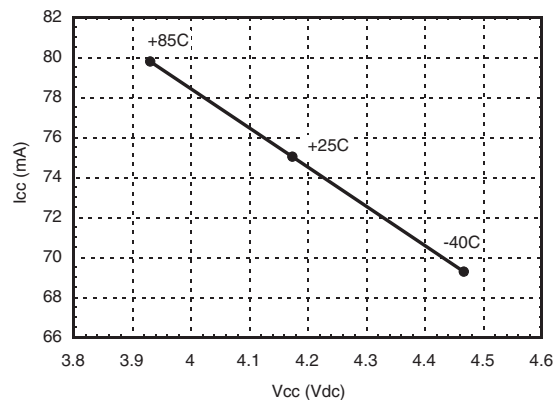
**Output IP3 vs. Temperature**



**Gain, Power & OIP3 vs. Supply Voltage  
for Constant  $I_{CC} = 72$  mA @ 850 MHz**



**$V_{CC}$  vs.  $I_{CC}$  Over Temperature for  
Fixed  $V_S = 8$  V,  $R_{BIAS} = 51$  Ohms**



### Absolute Maximum Ratings

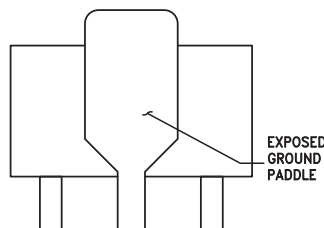
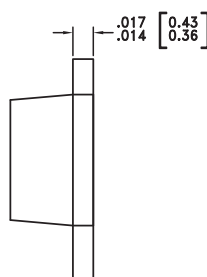
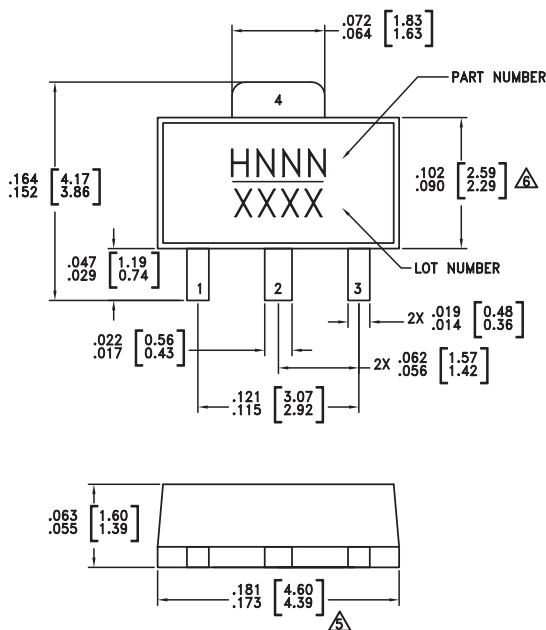
|                                                                  |                |
|------------------------------------------------------------------|----------------|
| Collector Bias Voltage (Vcc)                                     | +6.0 Vdc       |
| RF Input Power (RFIN)(Vcc = +4.2 Vdc)                            | +17 dBm        |
| Junction Temperature                                             | 150 °C         |
| Continuous Pdiss (T = 85 °C)<br>(derate 14.76 mW/°C above 85 °C) | 0.960 W        |
| Thermal Resistance<br>(junction to lead)                         | 67.6 °C/W      |
| Storage Temperature                                              | -65 to +150 °C |
| Operating Temperature                                            | -40 to +85 °C  |



ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS

8

### Outline Drawing



#### NOTES:

1. PACKAGE BODY MATERIAL:  
MOLDING COMPOUND MP-180S OR EQUIVALENT.
2. LEAD MATERIAL: Cu w/ Ag SPOT PLATING.
3. LEAD PLATING: 100% MATTE TIN.
4. DIMENSIONS ARE IN INCHES [MILLIMETERS]
5. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
6. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
7. ALL GROUND LEADS MUST BE SOLDERED TO PCB RF GROUND.

### Package Information

| Part Number | Package Body Material                              | Lead Finish   | MSL Rating          | Package Marking <sup>[3]</sup> |
|-------------|----------------------------------------------------|---------------|---------------------|--------------------------------|
| HMC479ST89  | Low Stress Injection Molded Plastic                | Sn/Pb Solder  | MSL1 <sup>[1]</sup> | H479<br>XXXX                   |
| HMC479ST89E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 <sup>[2]</sup> | H479<br>XXXX                   |

[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

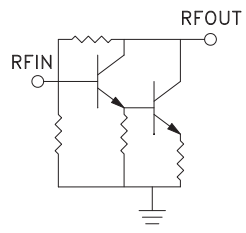
[3] 4-Digit lot number XXXX

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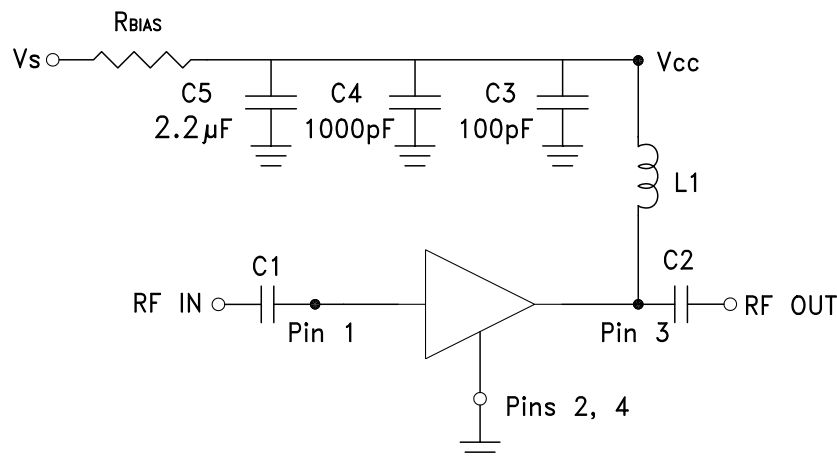
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Application Support: Phone: 978-250-3343 or [apps@hittite.com](mailto:apps@hittite.com)

### Pin Descriptions

| Pin Number | Function | Description                                                               | Interface Schematic                                                                 |
|------------|----------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1          | RFIN     | This pin is DC coupled.<br>An off chip DC blocking capacitor is required. |  |
| 3          | RFOUT    | RF output and DC Bias (Vcc) for the output stage.                         |                                                                                     |
| 2, 4       | GND      | These pins and package bottom must be connected to RF/<br>DC ground.      |  |

### Application Circuit



### Recommended Bias Resistor Values for $I_{CC} = 75 \text{ mA}$ , $R_{BIAS} = (V_s - V_{CC}) / I_{CC}$

| Supply Voltage (Vs) | 5V          | 6V          | 8V          | 10V         | 12V          |
|---------------------|-------------|-------------|-------------|-------------|--------------|
| RBIAS VALUE         | 13 $\Omega$ | 27 $\Omega$ | 51 $\Omega$ | 82 $\Omega$ | 110 $\Omega$ |
| RBIAS POWER RATING  | 1/8 W       | 1/4 W       | 1/2 W       | 1/2 W       | 1 W          |

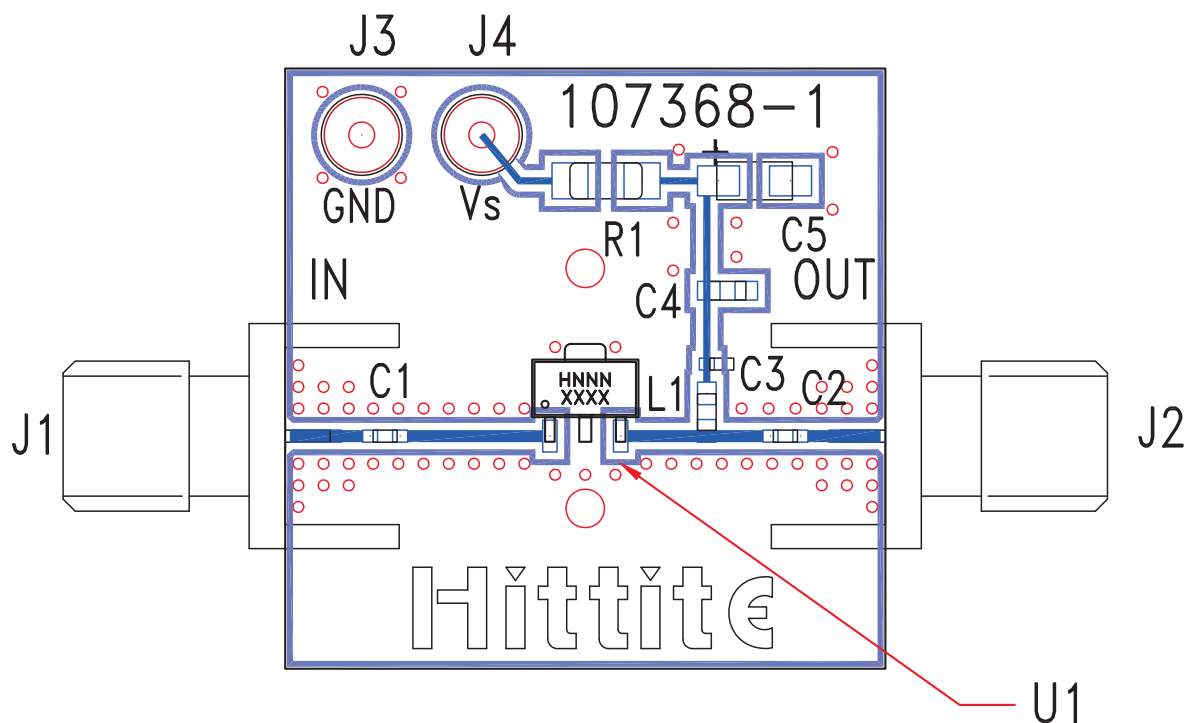
Note:

1. External blocking capacitors are required on RFIN and RFOUT.
2. RBIAS provides DC bias stability over temperature.

### Recommended Component Values for Key Application Frequencies

| Component | Frequency (MHz)    |        |        |        |        |        |        |
|-----------|--------------------|--------|--------|--------|--------|--------|--------|
|           | 50                 | 900    | 1900   | 2200   | 2400   | 3500   | 5000   |
| L1        | 270 nH             | 56 nH  | 18 nH  | 18 nH  | 15 nH  | 8.2 nH | 6.8 nH |
| C1, C2    | 0.01 $\mu\text{F}$ | 100 pF | 100 pF | 100 pF | 100 pF | 100 pF | 100 pF |

### Evaluation PCB



### List of Materials for Evaluation PCB 108323 [1]

| Item    | Description                     |
|---------|---------------------------------|
| J1 - J2 | PCB Mount SMA Connector         |
| J3 - J4 | DC Pin                          |
| C1, C2  | Capacitor, 0402 Pkg.            |
| C3      | 100 pF Capacitor, 0402 Pkg.     |
| C4      | 1000 pF Capacitor, 0603 Pkg.    |
| C5      | 2.2 $\mu$ F Capacitor, Tantalum |
| R1      | Resistor, 1210 Pkg.             |
| L1      | Inductor, 0603 Pkg.             |
| U1      | HMC479ST89 / HMC479ST89E        |
| PCB [2] | 107368 Evaluation PCB           |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

The circuit board used in the final application should use RF circuit design techniques. Signal lines should have 50 Ohm impedance while the package ground leads and package bottom should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation board should be mounted to an appropriate heat sink. The evaluation circuit board shown is available from Hittite upon request.