# HMC548LP3 / 548LP3E

v03.1011

## SiGe HBT MMIC LOW NOISE AMPLIFIER, 1.2 - 3.0 GHz

### Typical Applications

The HMC548LP3 / HMC548LP3E is ideal for:

- Automotive Telematics
- GPS Antenna Modules / Boosters
- Location Based Portables
- Satellite Navigation

### Features

Single Supply: Vcc = +3 to +5V

Low Noise Figure: 1.3 dB

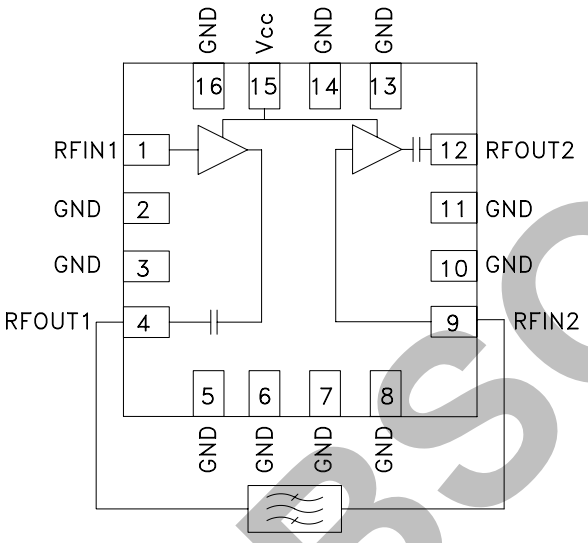
High Output IP3: +21 dBm

No External Matching Required

External Filter Access

3x3 mm Leadless SMT Package

### Functional Diagram




### General Description

The HMC548LP3 & HMC548LP3E are comprised of two internally matched SiGe HBT MMIC low noise amplifier stages housed in 3x3 mm leadless SMT packages. The unique topology of the HMC548LP3 & HMC548LP3E provides interstage access allowing the designer to place a bandpass filter between the two amplifier stages. This filtering approach enables the receiver to reject nearby blocking signals such as those emitted from cellular and 3G hand-helds, without incurring the noise figure degradation associated with a high rejection pre-filter. When combined with the appropriate interstage bandpass filter, this LNA can be used as a receiver pre-amplifier in various applications from 1.2 to 3 GHz. Evaluation boards are available with or without a GPS L1 (1575 MHz) band pass filter.



### Electrical Specifications, $T_A$ = +25°C*

| Parameter | Min. | Typ. | Max. | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| Frequency Range | 1575 | | | | | | MHz |
| Vcc | +3 | | | +5 | | | V |
| Gain | 20 | 23 | | 23 | 26 | | dB |
| Gain Variation Over Temperature | | 0.04 | 0.05 | | 0.04 | 0.05 | dB/°C |
| Noise Figure | | 1.6 | 1.9 | | 1.3 | 1.6 | dB |
| Input Return Loss | | 8 | | | 8 | | dB |
| Output Return Loss | | 14 | | | 16 | | dB |
| Output 1 dB Compression (P1dB) | | 8 | | | 11 | | dBm |
| Saturated Output Power (Psat) | | 10.5 | | | 12 | | dBm |
| Output Third Order Intercept (IP3) | | 13 | | | 21 | | dBm |
| Supply Current (Icc) | | 10 | 15 | | 21 | 30 | mA |

** All measurements include external 1.57 - 1.6 GHz (GPS L1) band pass filter connected between pin 4 & pin 9.*



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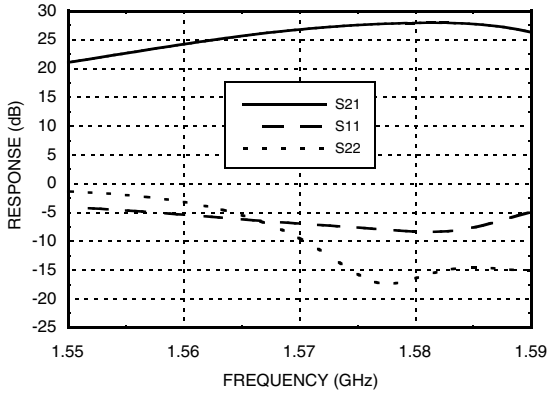
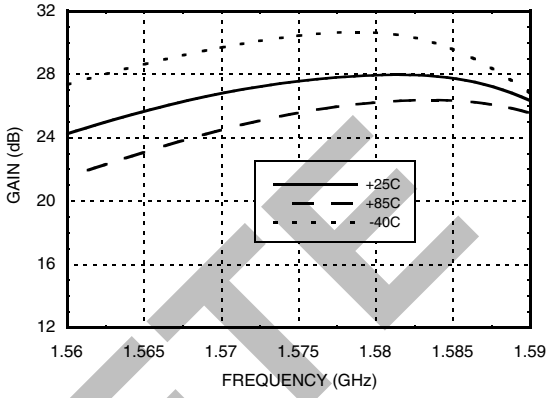
## SiGe HBT MMIC LOW NOISE AMPLIFIER, 1.2 - 3.0 GHz



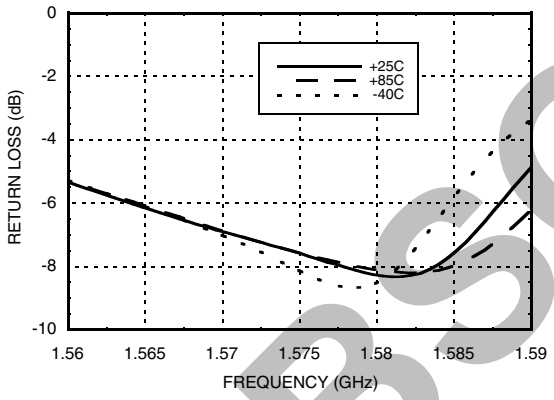
### Gain & Return Loss [1]



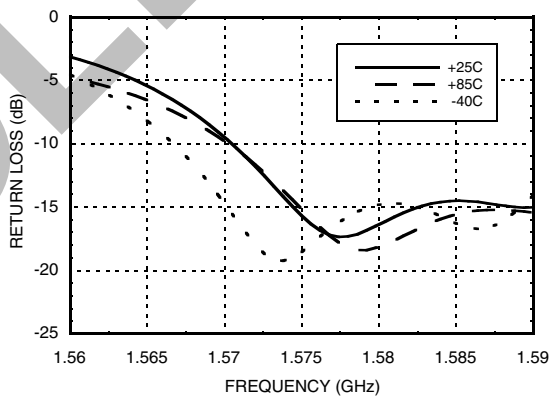

### Gain vs. Temperature [1]



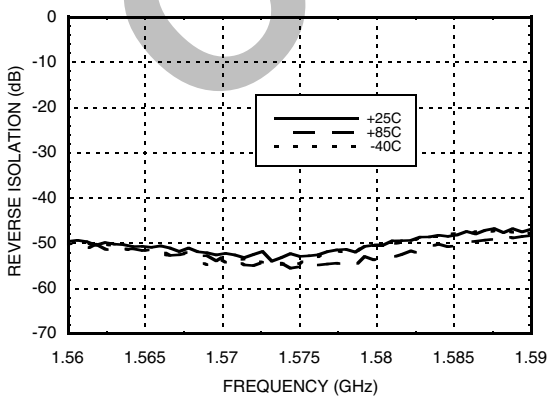

### Input Return Loss vs. Temperature [1]



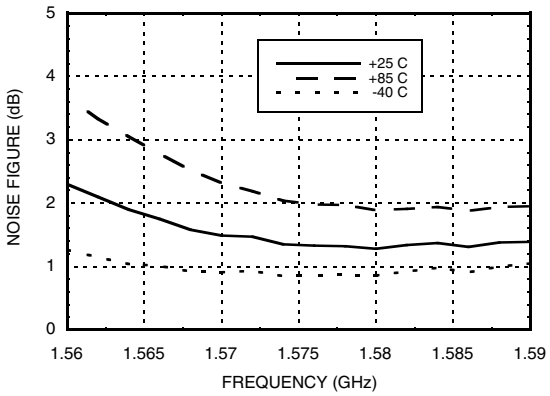

### Output Return Loss vs. Temperature [1]




### Reverse Isolation vs. Temperature [1]




### Noise Figure vs. Temperature [1]






[1] Measurement includes external 1.57 - 1.6 GHz (GPS L1) band pass filter connected between pin 4 and pin 9. Vcc = +5V.



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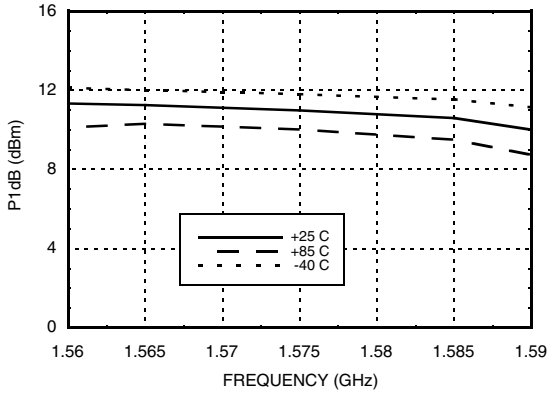
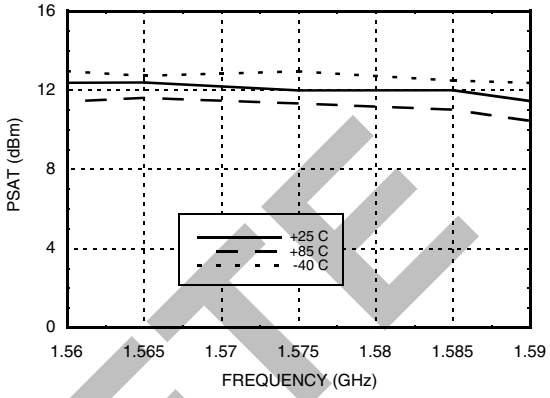
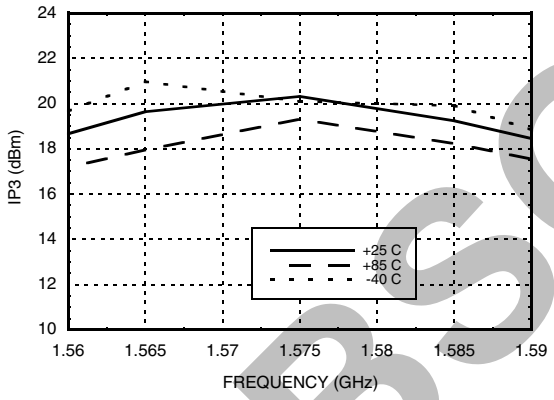
### P1dB vs. Temperature [1]



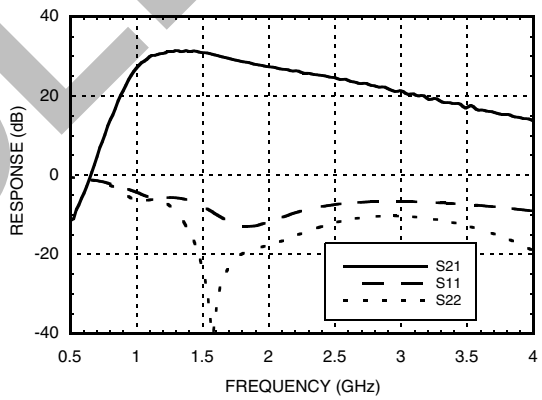

### Psat vs. Temperature [1]



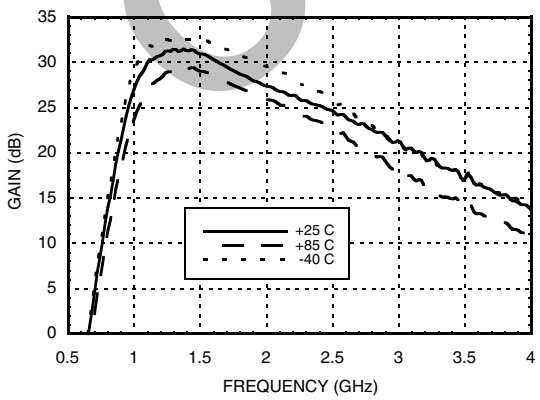

### Output IP3 vs. Temperature [1]



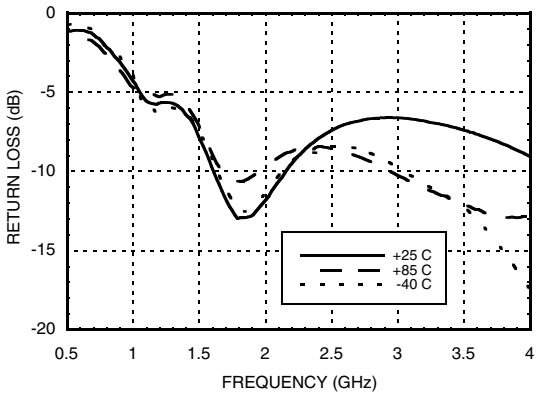

### Broadband Gain & Return Loss [2]




### Gain vs. Temperature [2]




### Input Return Loss vs. Temperature [2]






[1] Measurement includes external 1.57 - 1.6 GHz (GPS L1) band pass filter connected between pin 4 and pin 9. Vcc = +5V.

[2] Measurement includes external 50 Ohm line between pin 4 and pin 9. Vcc = +5V.



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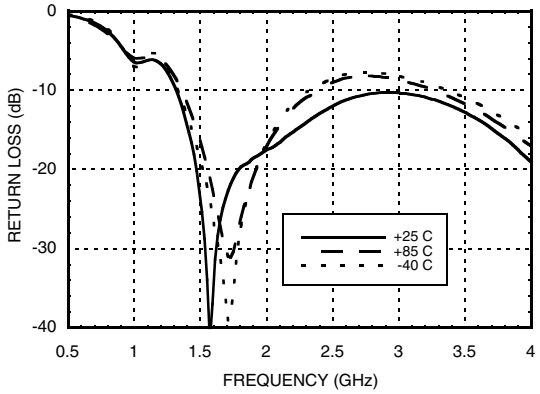
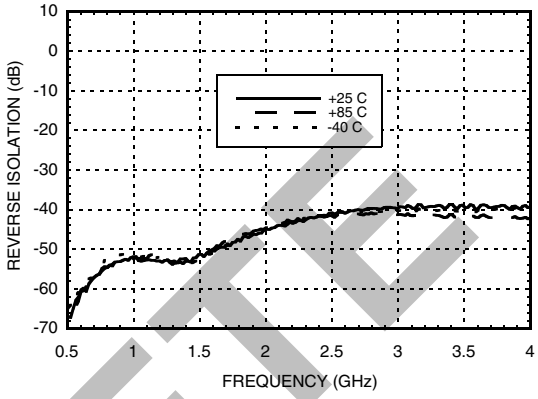
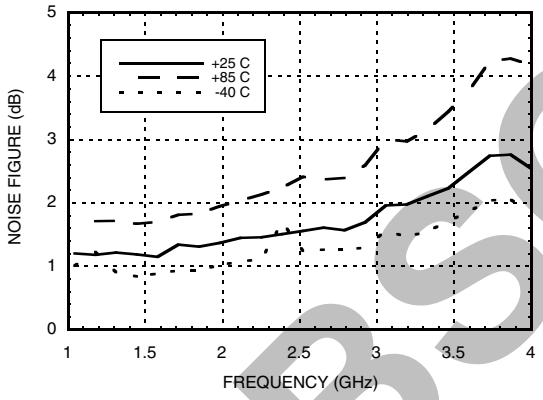
### Output Return Loss vs. Temperature [2]



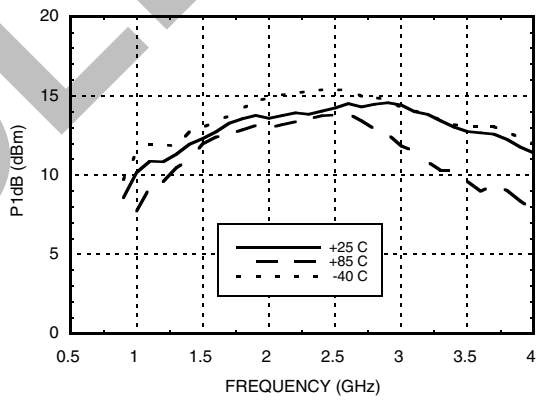

### Reverse Isolation vs. Temperature [2]



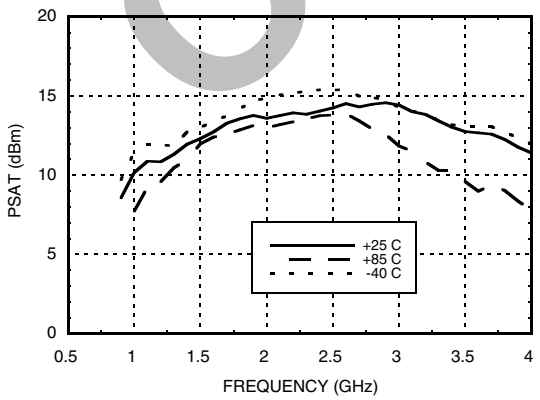

### Noise Figure vs. Temperature [2]



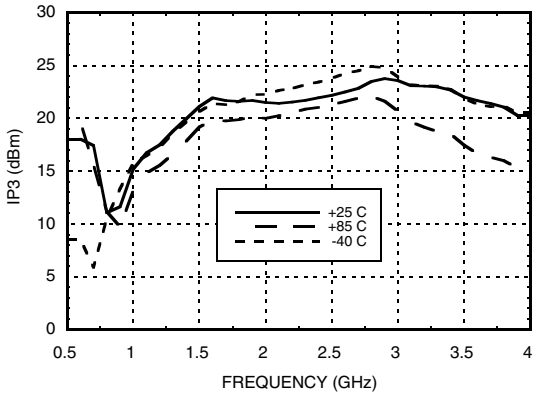

### P1dB vs. Temperature [2]




### Psat vs. Temperature [2]




### Output IP3 vs. Temperature [2]






[2] Measurement includes external 50 Ohm line between pin 4 and pin 9. Vcc = +5V.



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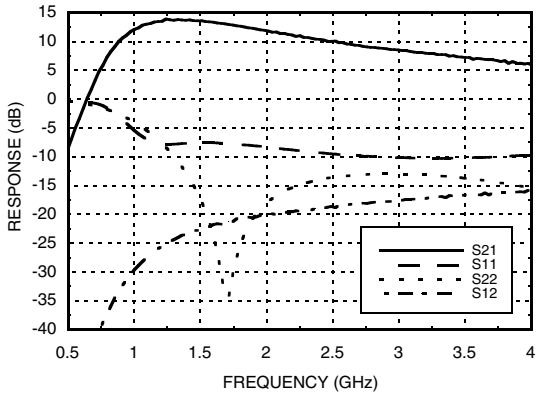
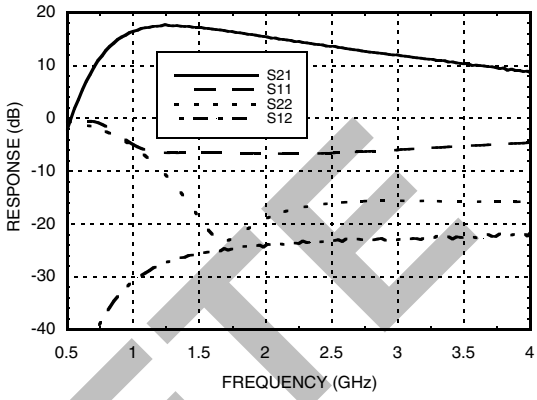
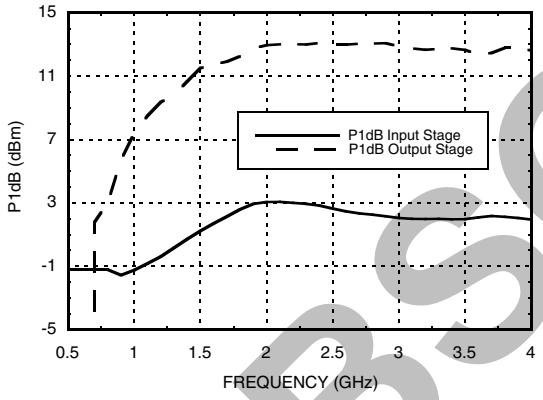
### Small Signal Parameters Input Stage [3]



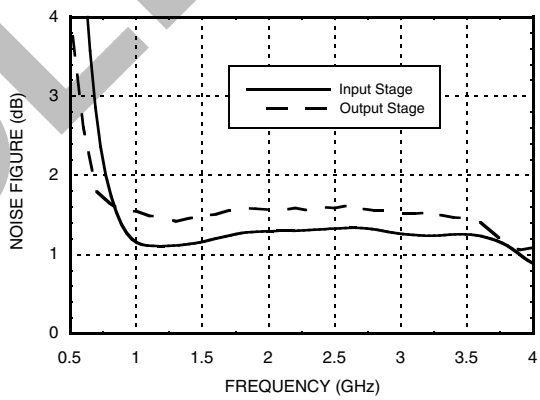

### Small Signal Parameters Output Stage [3]




### P1dB Individual Stages [3]




### Noise Figure Individual Stages [3]






[3] Vcc = +5V.



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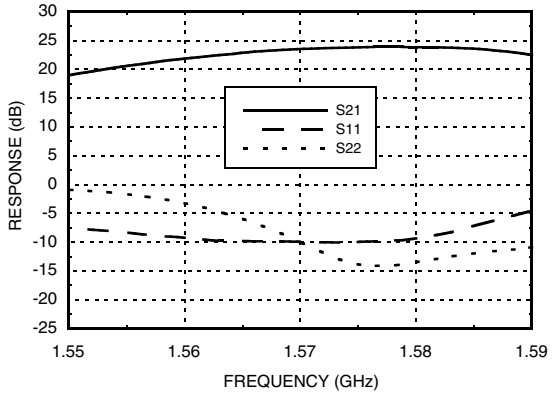
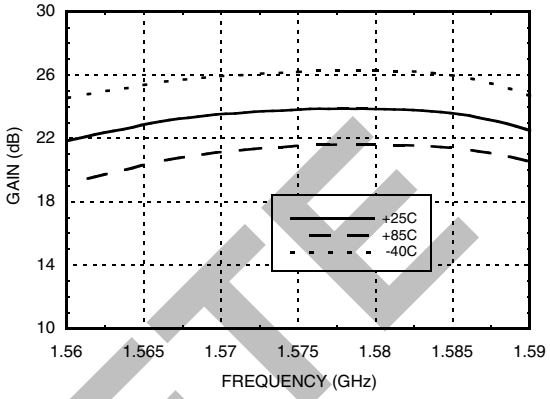
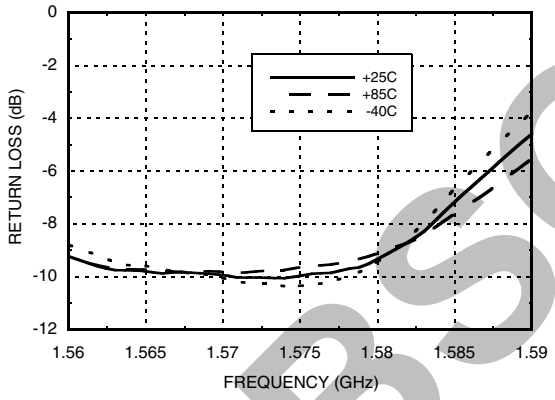
### Gain & Return Loss [4]



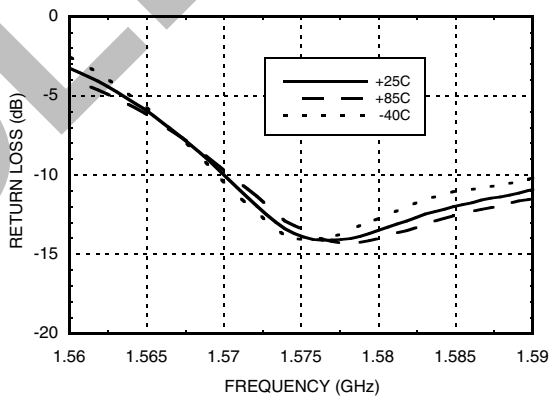

### Gain vs. Temperature [4]



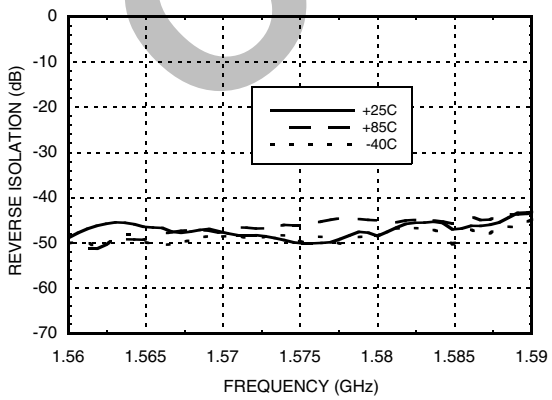

### Input Return Loss vs. Temperature [4]



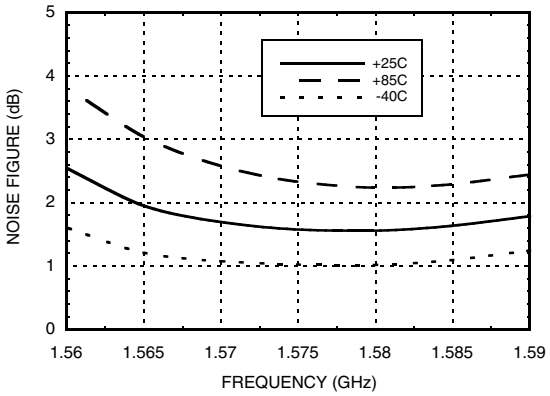

### Output Return Loss vs. Temperature [4]




### Reverse Isolation vs. Temperature [4]




### Noise Figure vs. Temperature [4]






[4] Measurement includes external 1.57 - 1.6 GHz (GPS L1) band pass filter connected between pin 4 and pin 9. Vcc = +3V.



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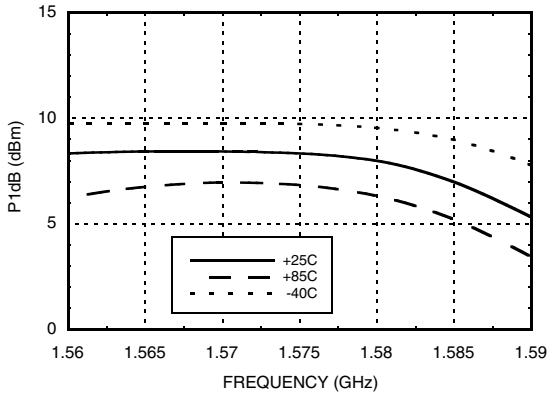
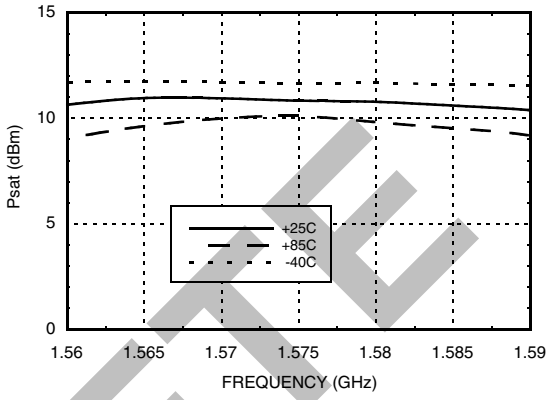
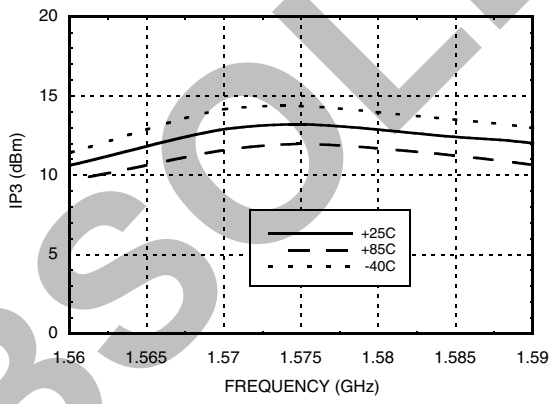
### P1dB vs. Temperature [4]




### Psat vs. Temperature [4]




### Output IP3 vs. Temperature [4]






### Absolute Maximum Ratings

| | |
|---|---|
| Drain Bias Voltage (Vcc) | +7.0 Vdc |
| RF Input Power (RFIN) | -5 dBm |
| Junction Temperature | 150 °C |
| Continuous Pdiss (T = 85 °C) (derate 14 mW/°C above 85 °C) | 0.942 W |
| Thermal Resistance (junction to ground paddle) | 69 °C/W |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -40 to +85 °C |
| ESD Sensitivity (HBM) | Class 1B |

### Typical Supply Current vs. Vcc

| Vcc (Vdc) | Icc (mA) |
|---|---|
| 3.0 | 10 |
| 4.5 | 17 |
| 5.0 | 21 |
| 5.5 | 24 |

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

[4] Measurement includes external 1.57 - 1.6 GHz (GPS L1) band pass filter connected between pin 4 and pin 9. Vcc = +3V.



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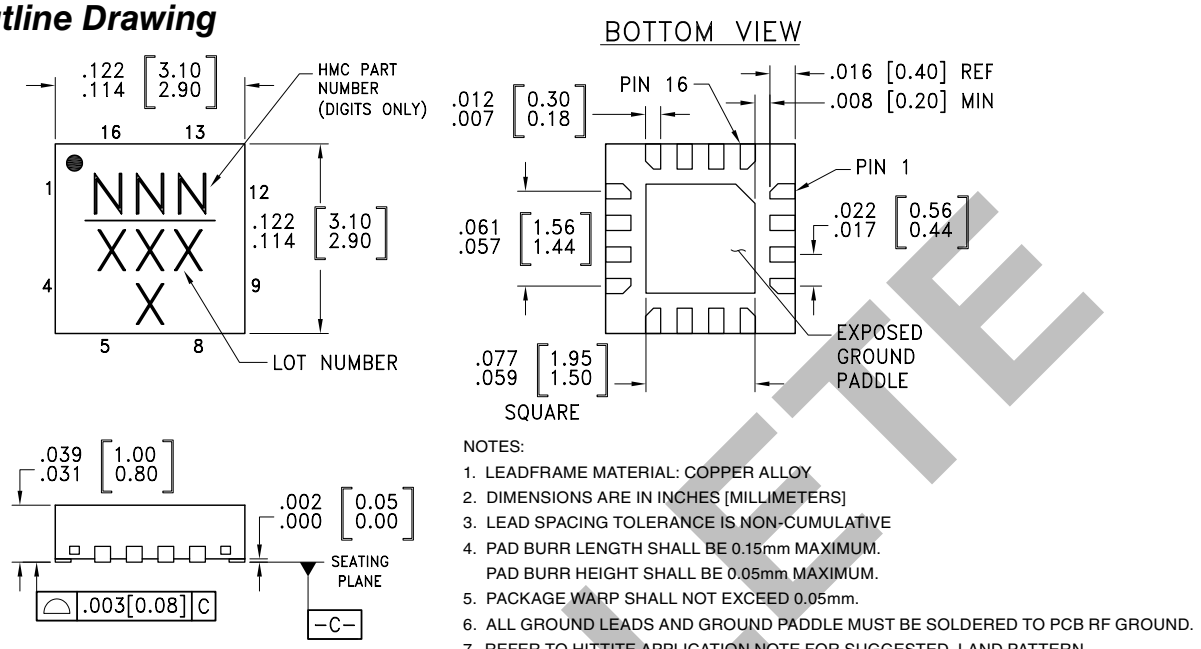
## SiGe HBT MMIC LOW NOISE AMPLIFIER, 1.2 - 3.0 GHz



## Outline Drawing




NOTES:

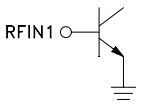
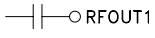
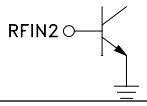
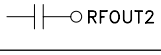
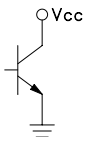
1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE
4. PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM. PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
5. PACKAGE WARP SHALL NOT EXCEED 0.05mm.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
7. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.

## Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking [3] |
|---|---|---|---|---|
| HMC548LP3 | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 [1] | 548<br>XXXX |
| HMC548LP3E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 [2] | 548<br>XXXX |

[1] Max peak reflow temperature of 235 °C
[2] Max peak reflow temperature of 260 °C
[3] 4-Digit lot number XXXX

## Pin Descriptions

| Pin Number | Function | Description | Interface Schematic |
|---|---|---|---|
| 1 | RFIN1 | This pin is DC coupled and matched to 50 Ohms from 1.2 to 2.0 GHz. An off chip blocking capacitor is required. |   |
| 2, 3, 5 - 8,10, 11, 13, 14, 16 | GND | These pins and package ground paddle must be connected to RF/DC ground. |   |
| 4 | RFOUT1 | This pin is AC coupled and matched to 50 Ohms from 1.2 - 2 GHz. |   |
| 9 | RFIN2 | This pin is DC coupled and matched to 50 Ohms from 1.2 to 2.0 GHz. An off chip blocking capacitor is required. |   |
| 12 | RFOUT2 | This pin is AC coupled and matched to 50 Ohms from 1.2 - 2 GHz. |   |
| 15 | Vcc | Power supply voltage for the amplifier. External bypass capacitors of 1,000pF and 18,000 pF are required. |   |





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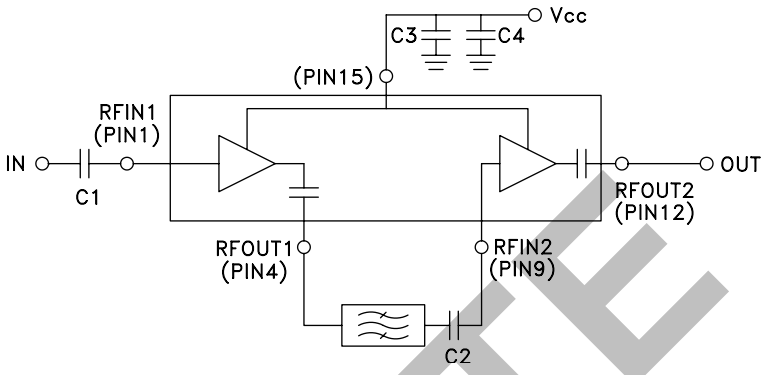
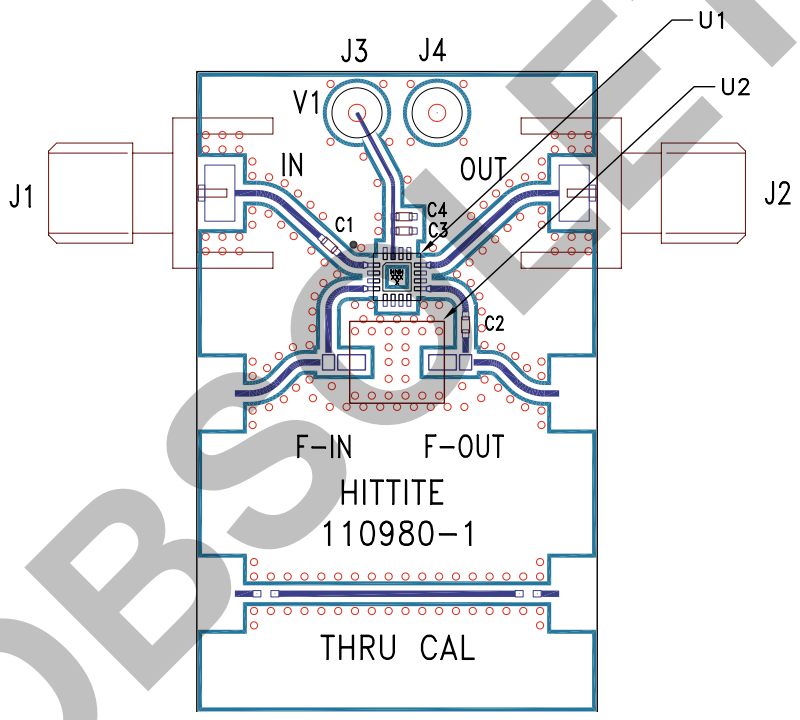
## SiGe HBT MMIC LOW NOISE AMPLIFIER, 1.2 - 3.0 GHz

### Application Circuit

| Component | Value |
|---|---|
| C1, C2 | 150 pF |
| C3 | 1,000 pF |
| C4 | 18,000 pF |




### 1575 MHz Evaluation PCB




### List of Material for Evaluation PCB 114254 [1]

| Item | Description |
|---|---|
| J1, J2 | PCB Mount SMA Connector |
| J3, J4 | DC Pin |
| C1, C2 | 150 pF Capacitor, 0402 Pkg. |
| C3 | 1000 pF Capacitor, 0402 Pkg. |
| C4 | 18,000 pF Capacitor, 0402 Pkg. |
| U1 | HMC548LP3 / HMC548LP3E Amplifier |
| U2 | Filter, Amotech AMOBP1575P02-A1 2.5 dB loss @ 1575 MHz |
| PCB [2] | 110980 Evaluation PCB |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

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





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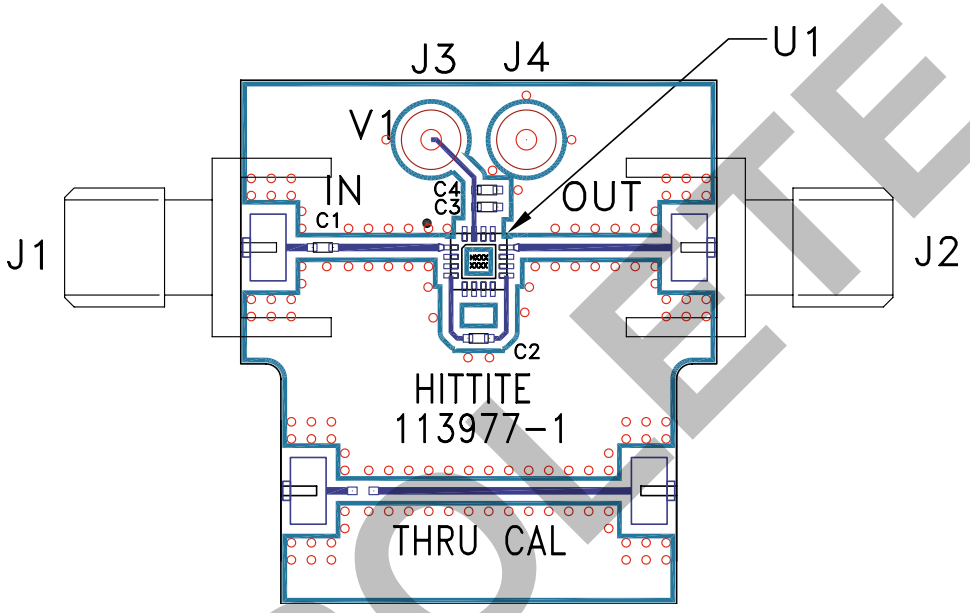
## Wideband (No Filter) Evaluation PCB






## List of Material for Evaluation PCB 113979 [1]

| Item | Description |
|---|---|
| J1, J2 | PCB Mount SMA Connector |
| J3, J4 | DC Pin |
| C1, C2 | 150 pF Capacitor, 0402 Pkg. |
| C3 | 1000 pF Capacitor, 0402 Pkg. |
| C4 | 18,000 pF Capacitor, 0402 Pkg. |
| U1 | HMC548LP3 / HMC548LP3E Amplifier |
| PCB [2] | 113977 Evaluation PCB |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

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



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