

### Typical Applications

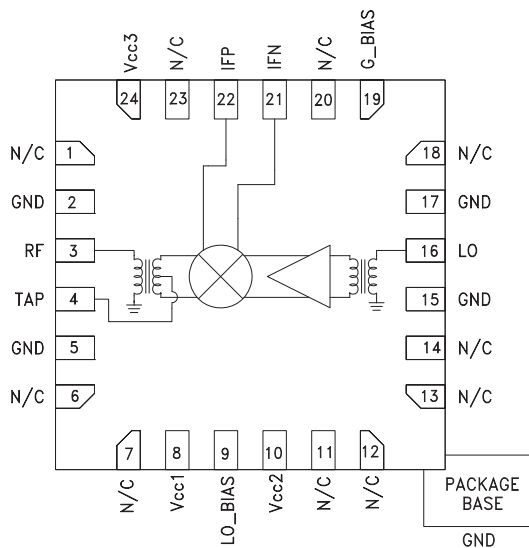
The HMC689LP4(E) is Ideal for:

- Cellular/3G & LTE/WiMAX/4G
- Basestations & Repeaters
- GSM, CDMA & OFDM
- Transmitters and Receivers

### Features

- High Input IP3: +32 dBm
- Low Conversion Loss: 7.5 dB
- Low LO Drive: 0 dBm
- Optimized for High Side LO Input
- Upconversion & Downconversion Applications
- 24 Lead 4x4mm SMT Package: 16mm<sup>2</sup>

### Functional Diagram



### General Description

The HMC689LP4(E) is a high dynamic range passive MMIC mixer with integrated LO amplifier in a 4x4 SMT QFN package covering 2.0 - 2.7 GHz. Excellent input IP3 performance of +32 dBm for down conversion is provided for 3G & 4G GSM/CDMA applications at an LO drive of 0 dBm. With an input 1 dB compression of +23 dBm, the RF port will accept a wide range of input signal levels. Conversion loss is 7.5 dB typical. The DC to 800 MHz IF frequency response will satisfy GSM/CDMA transmit or receive frequency plans. The HMC689LP4(E) is pin for pin compatible with the HMC688LP4(E) which is a 2.0 - 2.7 MHz mixer with LO amplifier, amplifier is optimized for low side LO applications.

### Electrical Specifications,

$T_A = +25^\circ C$ ,  $IF = 300 MHz$ ,  $LO = 0 dBm$ ,  $V_{cc} = V_{cc1}, 2, 3 = +5V$ ,  $G\_Bias = +2.8V^*$

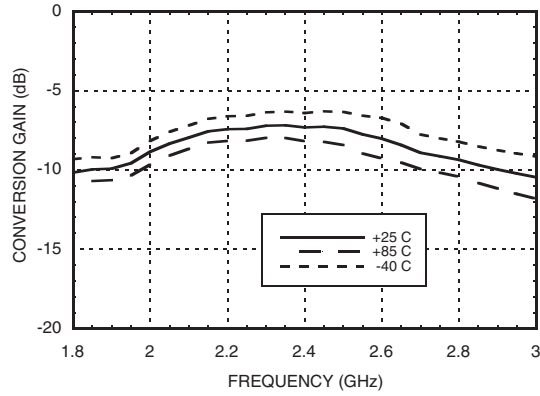
| Parameter                      | Min.      | Typ. | Max. | Units |
|--------------------------------|-----------|------|------|-------|
| Frequency Range, RF            | 2.0 - 2.7 |      |      | GHz   |
| Frequency Range, LO            | 2.0 - 3.0 |      |      | GHz   |
| Frequency Range, IF            | DC - 800  |      |      | MHz   |
| Conversion Loss                |           | 7.5  | 11   | dB    |
| Noise Figure (SSB)             |           | 7.5  |      | dB    |
| LO to RF Isolation             | 26        | 34   |      | dB    |
| LO to IF Isolation             | 20        | 26   |      | dB    |
| RF to IF Isolation             | 24        | 30   |      | dB    |
| IP3 (Input)                    |           | 32   |      | dBm   |
| 1 dB Compression (Input)       |           | 23   |      | dBm   |
| LO Drive Input Level (Typical) | -3 to +3  |      |      | dBm   |
| Supply Current (Icc total)     |           | 152  | 185  | mA    |

\* Unless otherwise noted all measurements performed as downconverter with high side LO & IF = 300 MHz.

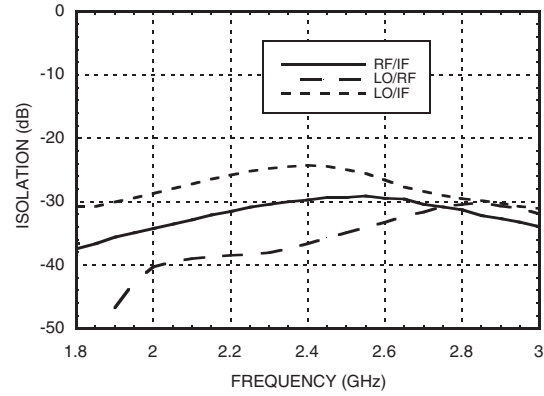


**BiCMOS MMIC MIXER W/ INTEGRATED  
LO AMPLIFIER, 2.0 - 2.7 GHz**

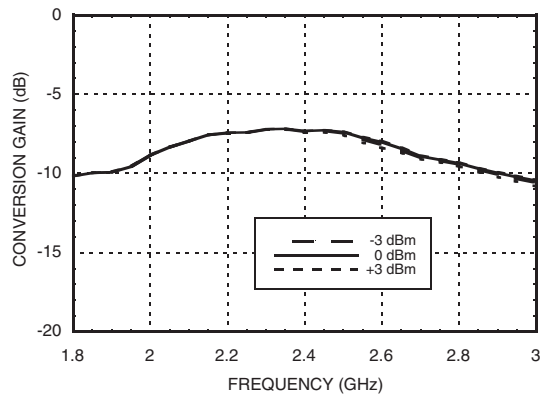
**Conversion Gain vs. Temperature**



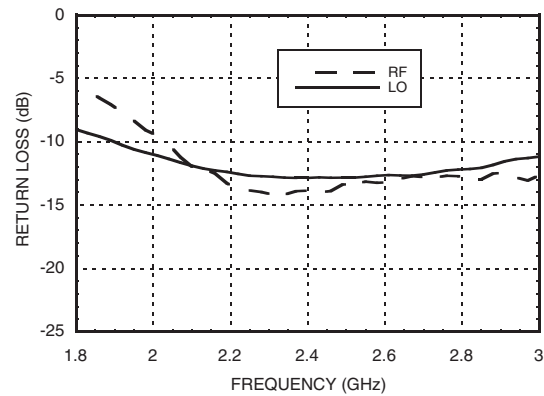
**Isolation**



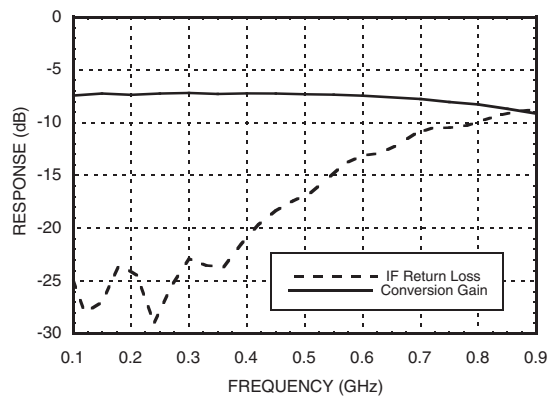
**Conversion Gain vs. LO Drive**



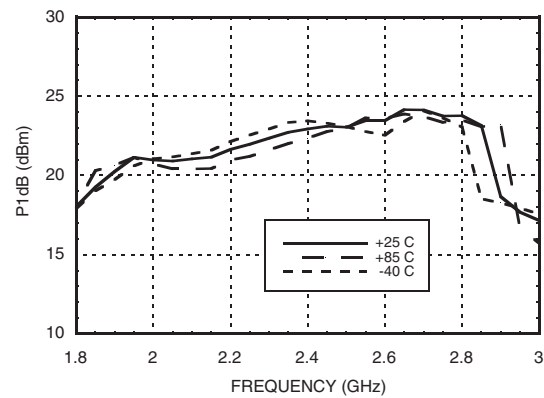
**Return Loss**



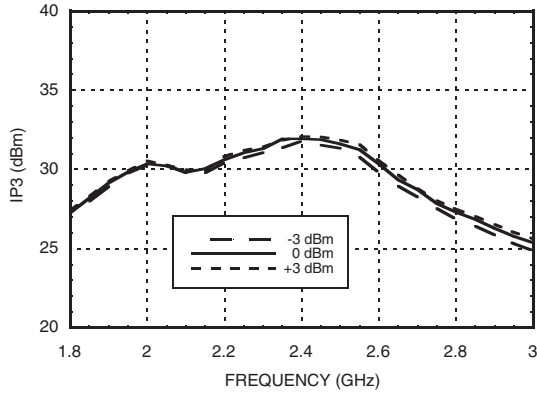
**IF Bandwidth (LO = 2.8 GHz)**



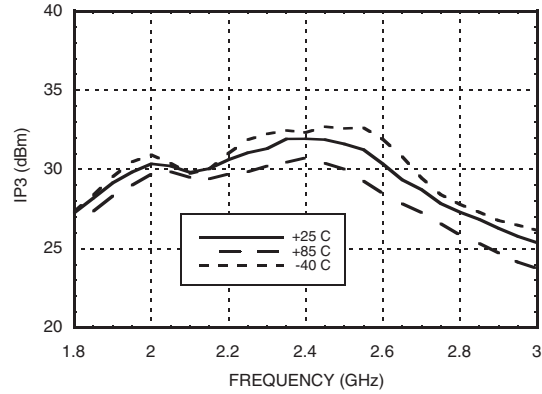
**Input P1dB vs. Temperature**



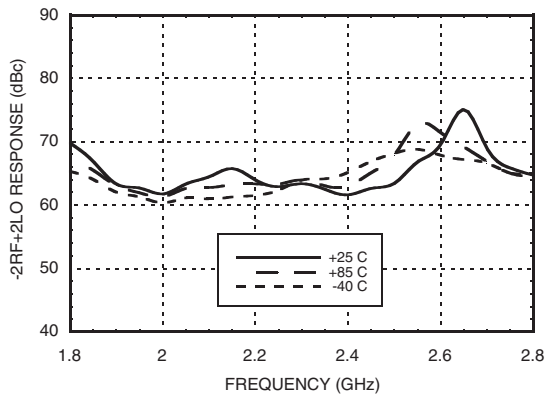
**Input IP3 vs. LO Drive <sup>[1]</sup>**



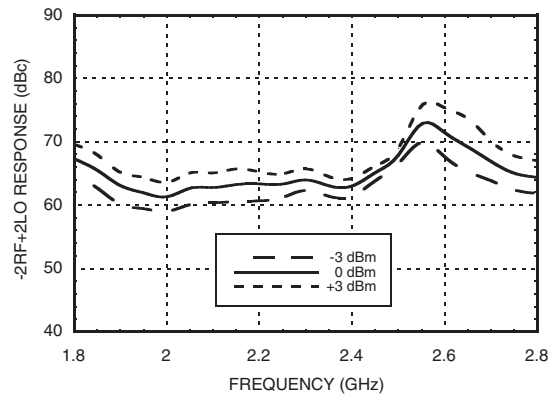
**Input IP3 vs. Temperature <sup>[1]</sup>**



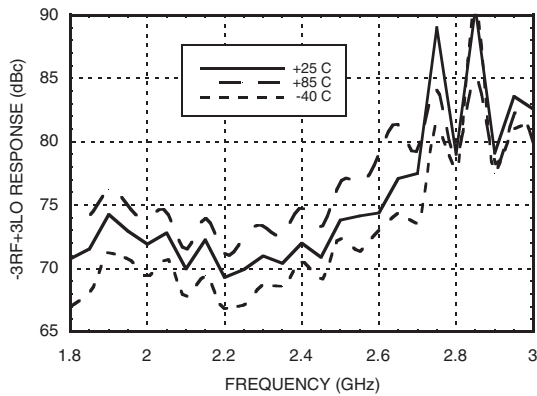
**-2RF +2LO Response vs. Temperature <sup>[2]</sup>**



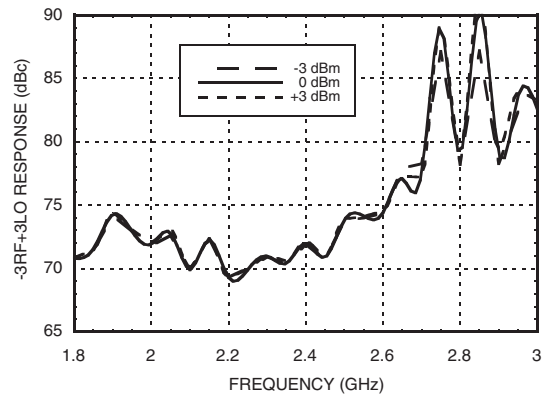
**-2RF +2LO Response vs. LO Drive <sup>[2]</sup>**



**-3RF +3LO Response vs. Temperature <sup>[2]</sup>**



**-3RF +3LO Response vs. LO Drive <sup>[2]</sup>**

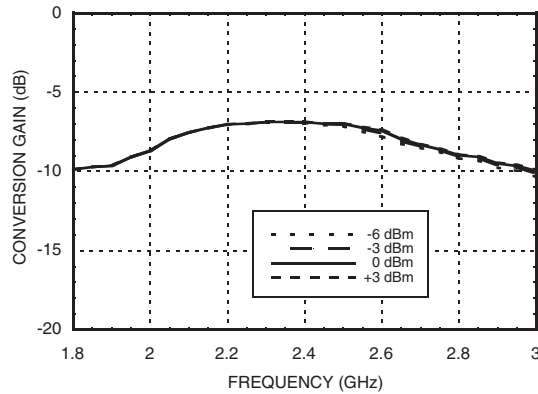


[1] Two-tone input power = +9 dBm each tone, 1 MHz spacing. [2] Referenced to RF Input power at 0 dBm

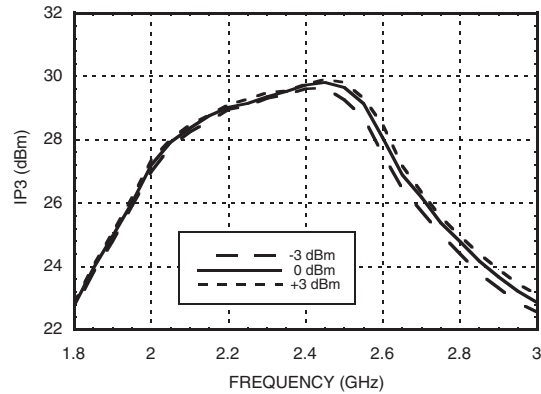


## BiCMOS MMIC MIXER W/ INTEGRATED LO AMPLIFIER, 2.0 - 2.7 GHz

### Upconverter Performance Conversion Gain vs. LO Drive



### Upconverter Performance Input IP3 vs. LO Drive <sup>[1]</sup>



### Absolute Maximum Ratings

|   |               |
|---|---------------|
| RF / IF Input (Vcc1, 2, 3 = +5V)  | +23 dBm       |
| LO Drive (Vcc1, 2, 3 = +5V)   | +10 dBm       |
| Vcc1, 2, 3  | +5.5V         |
| Channel Temperature   | 125 °C        |
| Continuous P <sub>diss</sub> (T = 85°C)<br>(derate 25 mW/°C above 85°C) | 1 W           |
| Thermal Resistance<br>(channel to ground paddle)                        | 40 °C/W       |
| Storage Temperature   | -65 to 150 °C |
| Operating Temperature   | -40 to +85 °C |

### MxN Spurious @ IF Port

|     |     | nLO |     |     |     |   |
|-----|-----|-----|-----|-----|-----|---|
| mRF |     | 0   | 1   | 2   | 3   | 4 |
| 0   | xx  | 23  | 34  | 34  | 38  |   |
| 1   | 28  | 0   | 46  | 42  | 55  |   |
| 2   | 73  | 73  | 52  | 66  | 85  |   |
| 3   | 109 | 81  | 94  | 67  | 96  |   |
| 4   | 120 | 117 | 120 | 111 | 110 |   |

RF Freq. = 2.5 GHz @ 0 dBm  
LO Freq. = 2.8 GHz @ 0 dBm  
All values in dBc below IF power level (-1RF + 1LO).

### Typical Supply Current vs. Vcc

| Vcc1, 2, 3 (V) | I <sub>cc</sub> total (mA) |
|----------------|----------------------------|
| 4.75           | 140                        |
| 5.00           | 152                        |
| 5.25           | 164                        |

Downconverter will operate over full voltage range shown above.



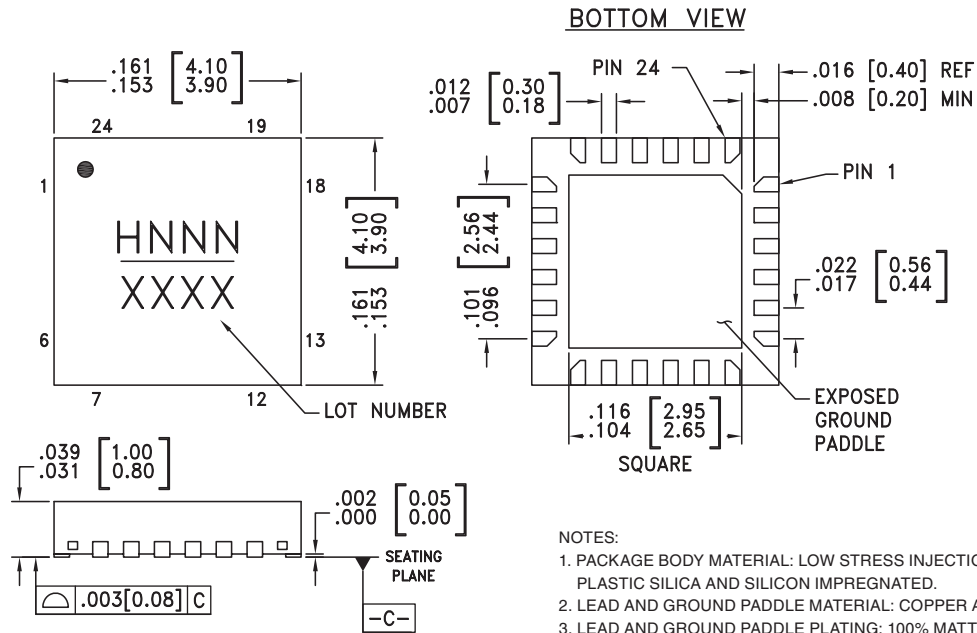
ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS

### Harmonics of LO

|                |    | nLO Spur @ RF Port |    |    |   |
|----------------|----|--------------------|----|----|---|
| LO Freq. (GHz) |    | 1                  | 2  | 3  | 4 |
| 2.1            | 32 | 26                 | 55 | 29 |   |
| 2.2            | 30 | 26                 | 51 | 30 |   |
| 2.3            | 29 | 27                 | 42 | 29 |   |
| 2.4            | 28 | 26                 | 44 | 29 |   |
| 2.5            | 26 | 25                 | 41 | 26 |   |
| 2.6            | 25 | 24                 | 42 | 26 |   |
| 2.7            | 24 | 23                 | 42 | 22 |   |
| 2.8            | 25 | 24                 | 40 | 26 |   |
| 2.9            | 26 | 22                 | 38 | 34 |   |

LO = 0 dBm  
All values in dBc below input LO level measured at RF port.

[1] Two-tone input power = +9 dBm each tone, 1 MHz spacing.

**Outline Drawing**

**NOTES:**

1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
2. LEAD AND GROUND PADDLE MATERIAL: COPPER ALLOY.
3. LEAD AND GROUND PADDLE PLATING: 100% MATTE TIN.
4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
5. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
6. PAD BURR LENGTH SHALL BE 0.15mm MAX.  
PAD BURR HEIGHT SHALL BE 0.25mm MAX.
7. PACKAGE WARP SHALL NOT EXCEED 0.05mm
8. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
9. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED PCB LAND PATTERN.

**Package Information**

| Part Number | Package Body Material                              | Lead Finish   | MSL Rating          | Package Marking <sup>[3]</sup> |
|-------------|--|---------------|---------------------|--------------------------------|
| HMC689LP4   | Low Stress Injection Molded Plastic                | Sn/Pb Solder  | MSL1 <sup>[1]</sup> | H689<br>XXXX                   |
| HMC689LP4E  | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 <sup>[2]</sup> | H689<br>XXXX                   |

[1] Max peak reflow temperature of 235 °C

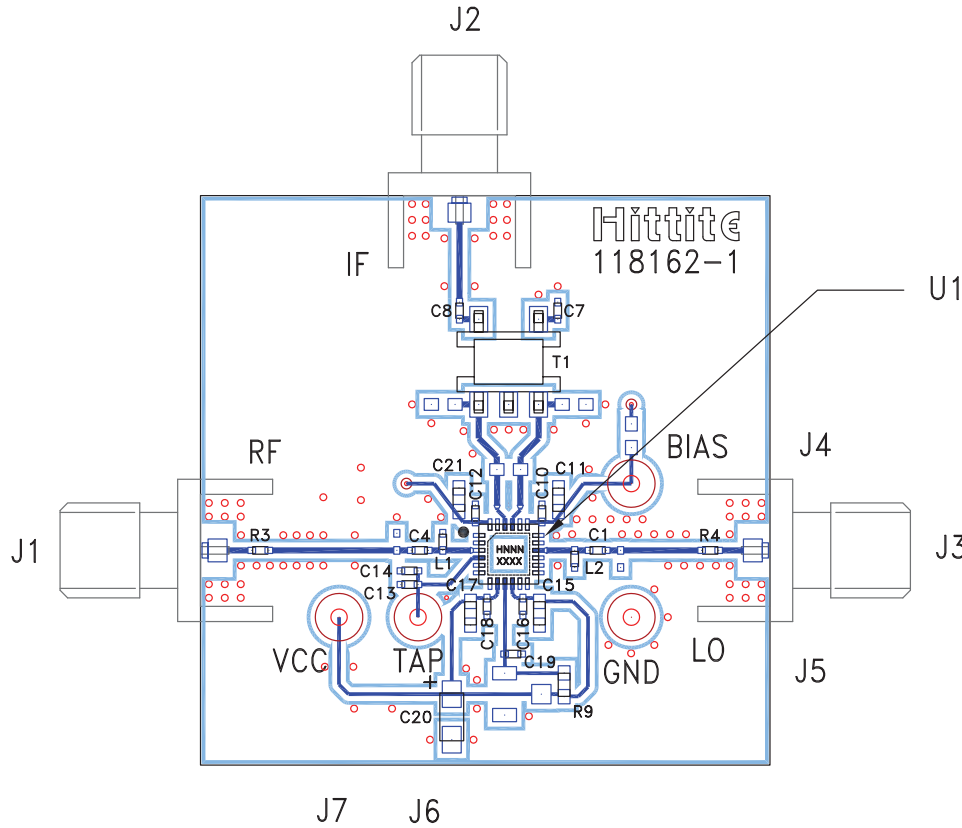
[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX

### Pin Descriptions

| Pin Number                   | Function         | Description  | Interface Schematic |
|------------------------------|------------------|--|---------------------|
| 1, 6, 7, 11 - 14, 18, 20, 23 | N/C              | No connection. These pins may be connected to RF ground. Performance will not be affected.   |                     |
| 2, 5, 15, 17                 | GND              | Package bottom must be connected to RF/DC ground.  |                     |
| 3                            | RF               | This pin is matched single-ended to 50 ohms and DC shorted to ground through a balun.  |                     |
| 4                            | TAP              | Center tap of secondary side of the internal RF balun. Short to ground with zero ohms close to the IC.   |                     |
| 8, 10, 24                    | Vcc1, Vcc2, Vcc3 | Power supply voltage. See application circuit for required external components.  |                     |
| 9                            | LO_BIAS          | Adjust the LO buffer current through an external resistor. See application circuit for required external components.   |                     |
| 16                           | LO               | This pin is matched single-ended to 50 ohms and DC shorted to ground through a balun.  |                     |
| 19                           | G_BIAS           | External optional bias. See application circuit for required external components. Apply +2.8V for nominal performance  |                     |
| 21, 22                       | IFN, IFP         | Differential IF input / output pins matched to differential 50 ohms. For applications not requiring operation to DC, an off chip DC blocking capacitor should be used. |                     |

### Evaluation PCB



### List of Materials for Evaluation PCB 120974 [1]

| Item               | Description                       |
|--------------------|-----------------------------------|
| J1 - J3            | SMA Connector                     |
| J4 - J7            | DC Pin                            |
| C1, C4             | 1.5 pF Capacitor, 0402 Pkg.       |
| C7, C8, C13        | 10 nF Capacitor, 0402 Pkg.        |
| C10, C12, C16, C18 | 1 nF Capacitor, 0402 Pkg.         |
| C11, C15, C17, C21 | 0.1 μF Capacitor, 0402 Pkg.       |
| C14, C19           | 22 pF Capacitor, 0402 Pkg.        |
| L1                 | 7.5 nH Inductor, 0402 Pkg.        |
| L2                 | 8.2 nH Inductor, 0402 Pkg.        |
| C20                | 4.7 μF Case A, Tantalum           |
| R3, R4             | 0 Ohm Resistor, 0402 Pkg.         |
| R9                 | 215 Ohm Resistor, 0603 Pkg.       |
| T1                 | 1:1 Transformer - Tyco MABACT0039 |
| U1                 | HMC689LP4(E) Downconverter        |
| PCB [2]            | 118162 Evaluation PCB             |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Arlon 25R, FR4

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 exposed paddle 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 circuit board shown is available from Hittite upon request.

### Application Circuit

