

### Typical Applications

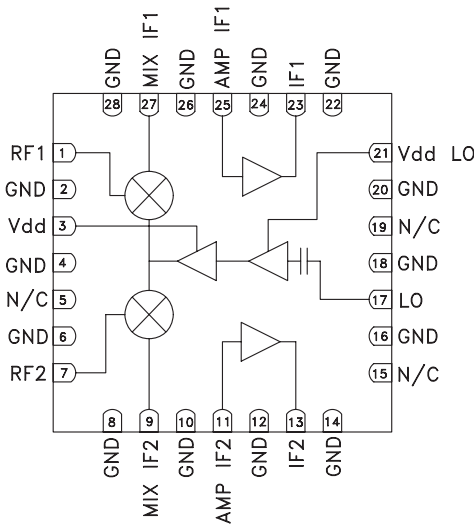
The HMC581LP6 / HMC581LP6E is ideal for Wireless Infrastructure Applications:

- GSM, GPRS & EDGE
- CDMA & W-CDMA
- Cellular / 3G Infrastructure

### Features

- +26 dBm Input IP3
- Low Single Input LO Drive: 0 dBm
- 9 dB Conversion Gain
- 13 dB Noise Figure
- Single Positive Supply: +5V @ 260 mA

### Functional Diagram



### General Description

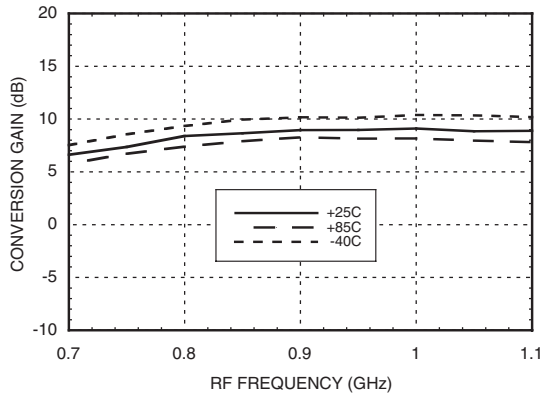
The HMC581LP6 & HMC581LP6E are high linearity Dual Down Converter Receiver ICs that operate from 800 - 960 MHz and deliver a +26 dBm input third order intercept point for UMTS & GSM applications. The passive mixer outputs and high dynamic range IF amplifier inputs are positioned so that an external IF filter can be placed in series between them. The converter provides a gain of 9 dB and typical single side band noise figure of 13 dB. The IC operates from a single +5V supply consuming 260 mA of current while requiring only 0 dBm LO drive. The design requires no external baluns, no external matching and supports IF frequencies between 50 and 300 MHz.

### Electrical Specifications, $T_A = +25^\circ C$ , LO = 0 dBm, Vdd = +5V, IF = 105 MHz\*

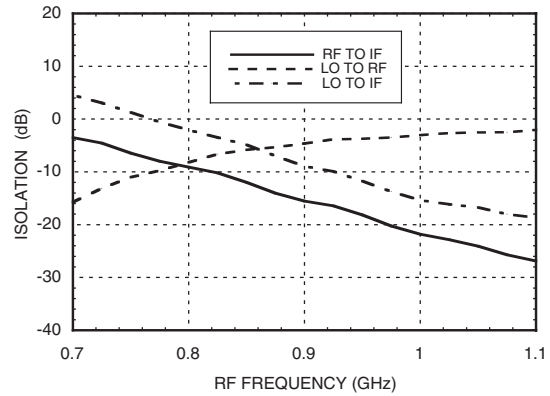
| Parameter  | Min. | Typ.       | Max. | Units |
|--|------|------------|------|-------|
| Frequency Range, RF  |      | 800 - 960  |      | MHz   |
| Frequency Range, LO  |      | 700 - 1160 |      | MHz   |
| Frequency Range, IF  |      | 50 - 300   |      | MHz   |
| Conversion Gain  | 7    | 9          |      | dB    |
| Noise Figure (SSB)   |      | 13         |      | dB    |
| LO to RF Isolation   |      | 4          |      | dB    |
| LO to IF Isolation   |      | 10         |      | dB    |
| RF to IF Isolation   |      | 15         |      | dB    |
| IP3 (Input)  | 23   | 26         |      | dBm   |
| 1 dB Compression (Input)   |      | 9.5        |      | dBm   |
| Branch Isolation   |      | 40         |      | dB    |
| LO Drive Input Level (Typical)   |      | -4 to +4   |      | dBm   |
| Supply Current (I <sub>dd</sub> for LO & IF)<br>(IF bias resistor= 4.7 Ohms) |      | 256        |      | mA    |

\* Unless otherwise noted all measurements with low side LO & IF = 105 MHz.

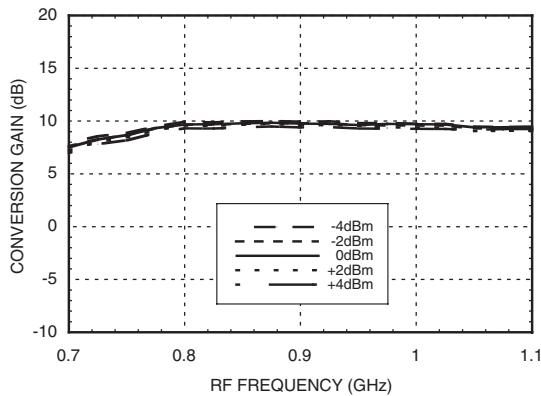
**Conversion Gain vs. Temperature**  
@ LO = 0 dBm, IF = 200 MHz



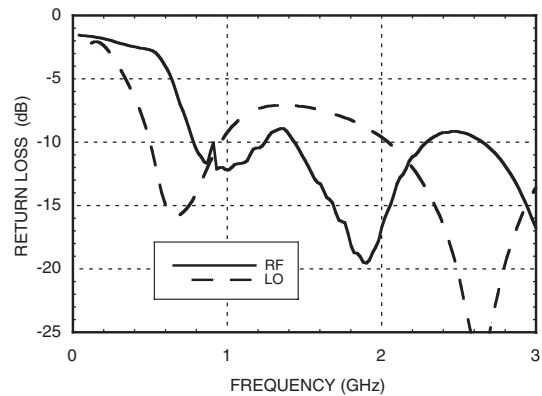
**Isolation @ LO = 0 dBm**



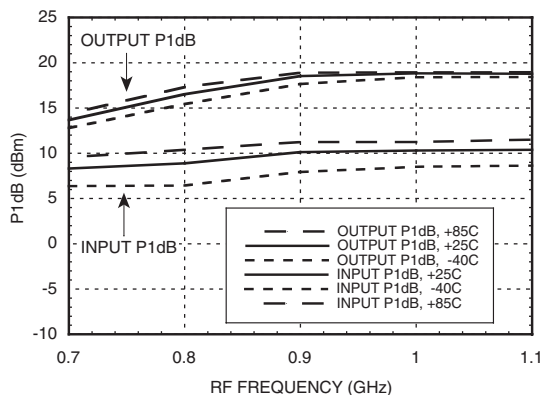
**Conversion Gain vs. LO Drive, IF = 105 MHz**



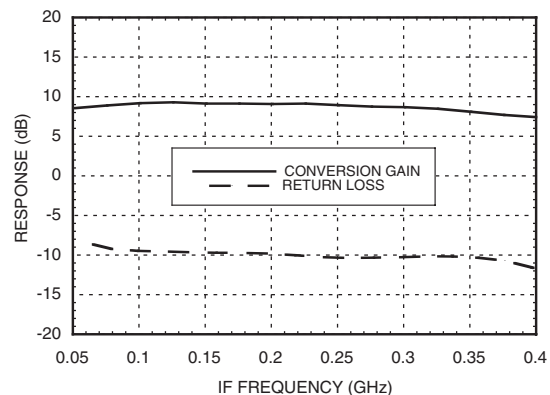
**Return Loss @ LO = 0 dBm**



**P1dB vs. Temperature**  
@ LO = 0 dBm, IF = 200 MHz



**IF Bandwidth, LO = 0 dBm**

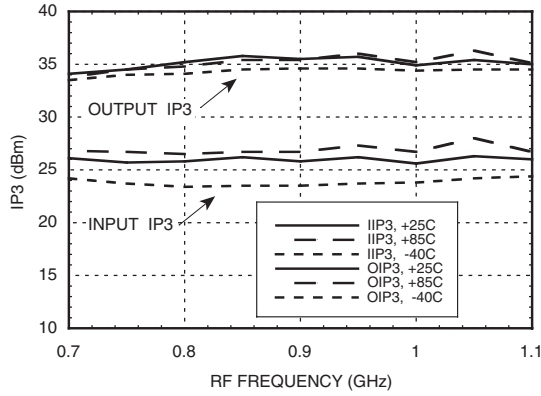


\* Unless otherwise noted all measurements with low side LO & IF = 105 MHz.

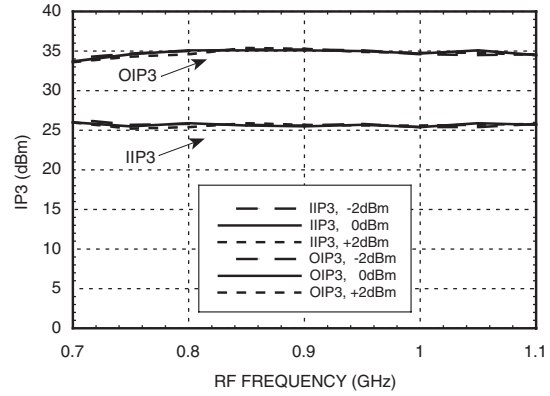


**HMC581LP6 / 581LP6E**  
**HIGH IP3 RFIC DUAL**  
**DOWNCONVERTER, 800 - 960 MHz**

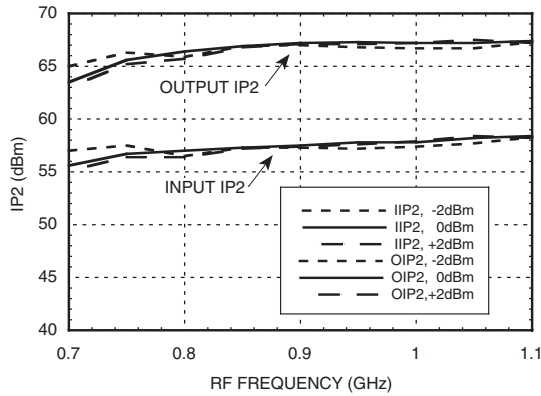
**Input & Output IP3 vs. Temperature**  
**@ LO = 0 dBm, IF = 200 MHz**



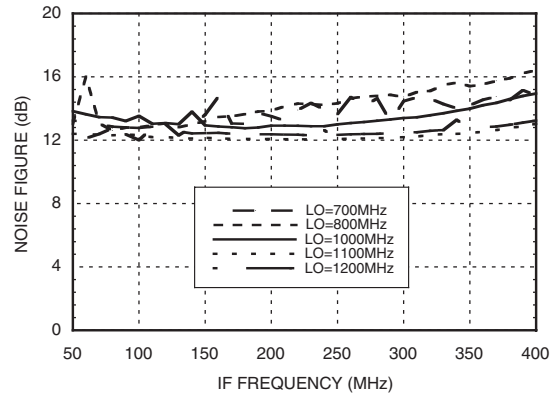
**Input & Output IP3 vs LO Drive,**  
**IF = 200 MHz**



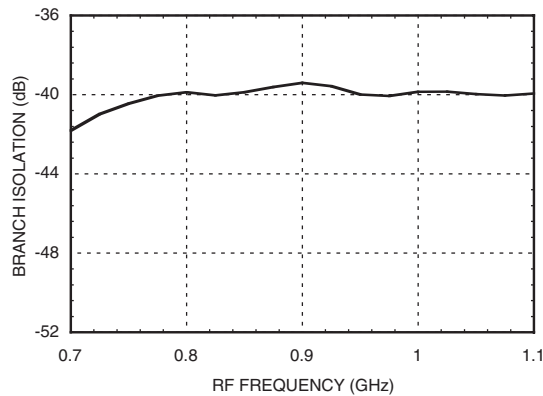
**Input & Output IP2 vs.**  
**LO Drive, IF = 200 MHz**



**Noise Figure vs. IF Frequency**



**Branch Isolation RF1, IF2 @ LO = 0 dBm**

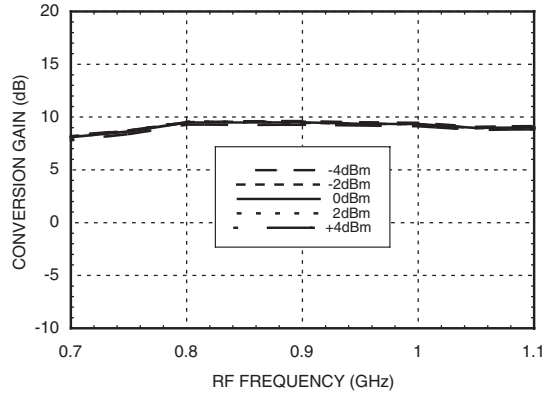


\* Unless otherwise noted all measurements with low side LO & IF = 105 MHz.

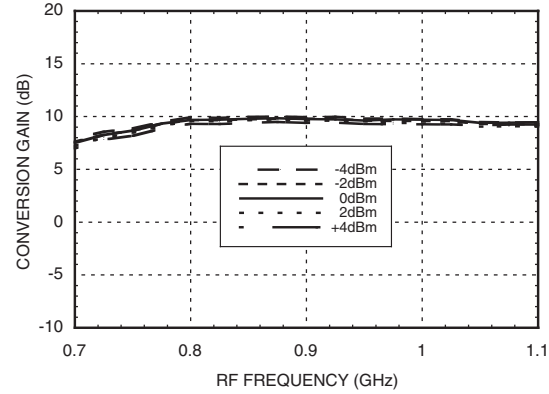


## HIGH IP3 RFIC DUAL DOWNCONVERTER, 800 - 960 MHz

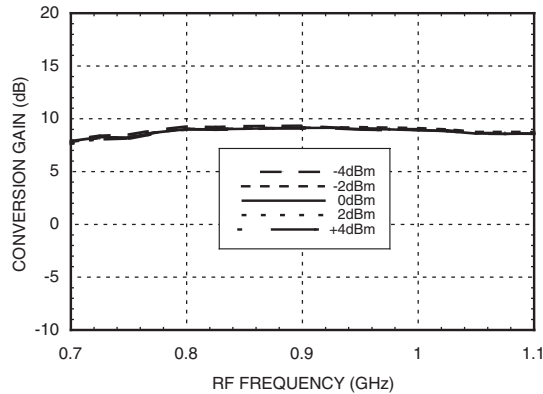
**Conversion Gain vs. LO Drive IF = 70 MHz**



**Conversion Gain vs. LO Drive, IF = 150 MHz**



**Conversion Gain vs. LO Drive, IF = 200 MHz**



**MxN Spurious @ IF Port**

|     | nLO |     |     |     |    |
|-----|-----|-----|-----|-----|----|
| mRF | 0   | 1   | 2   | 3   | 4  |
| 0   | xx  | 2   | 36  | 32  | 53 |
| 1   | 19  | 0   | 26  | 58  | 62 |
| 2   | 75  | 65  | 50  | 54  | 89 |
| 3   | 108 | 93  | 88  | 78  | 89 |
| 4   | 123 | 123 | 117 | 103 | 89 |

RF Freq. = 0.8 GHz @ -10 dBm  
LO Freq. = 0.7 GHz @ 0 dBm  
All values in dBc below IF power level (1RF - 1LO).

**Typical Supply Current vs. Vdd**

| Vdd (LO + IF) | Idd (mA) |
|---------------|----------|
| +4.5          | 190      |
| +5.0          | 260      |
| +5.5          | 340      |

Downconverter will operate over full voltage range shown above.

**Harmonics of LO**

|                | nLO Spur @ RF Port |    |    |    |
|----------------|--------------------|----|----|----|
| LO Freq. (GHz) | 1                  | 2  | 3  | 4  |
| 0.6            | 15                 | 16 | 14 | 26 |
| 0.7            | 7                  | 22 | 15 | 37 |
| 0.8            | 4                  | 23 | 19 | 46 |
| 0.9            | 3                  | 17 | 25 | 38 |
| 1              | 2                  | 17 | 23 | 25 |
| 1.1            | 1                  | 20 | 12 | 24 |

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

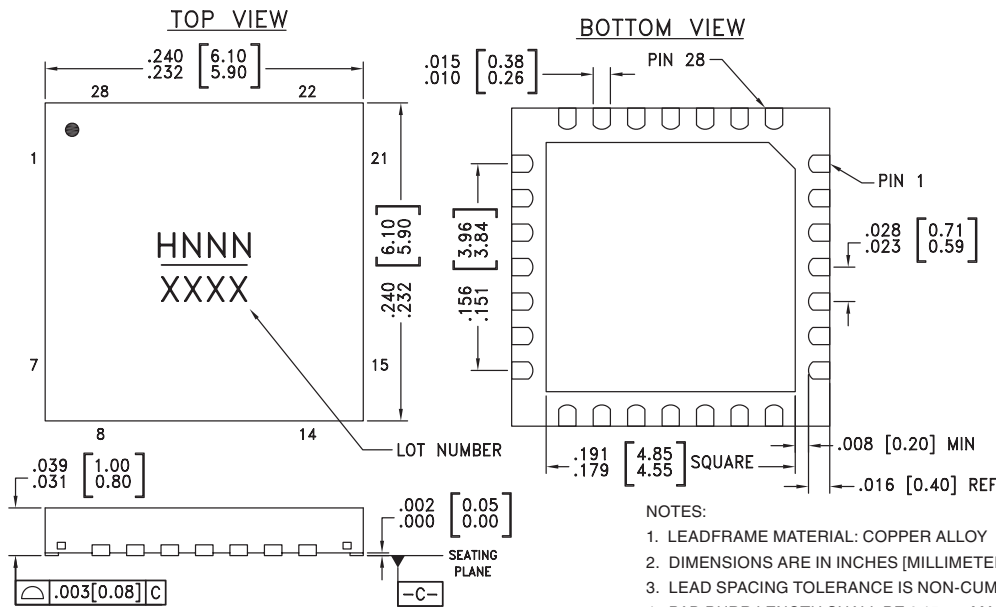
### Absolute Maximum Ratings

|   |               |
|---|---------------|
| RF / IF Input (Vdd= +5V)  | +13 dBm       |
| LO Drive (Vdd= +5V)   | +15 dBm       |
| Vdd (LO or IF)  | +7 Vdc        |
| Channel Temperature   | 150°C         |
| Continuous P <sub>diss</sub> (T = 85°C)<br>(derate 25.5 mW/°C above 85°C) | 1.64 W        |
| Thermal Resistance<br>(channel to ground paddle)                          | 39.6 °C/W     |
| Storage Temperature   | -65 to +150°C |
| Operating Temperature   | -40 to +85°C  |



ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS

### 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 <sup>[3]</sup> |
|-------------|--|---------------|---------------------|--------------------------------|
| HMC581LP6   | Low Stress Injection Molded Plastic                | Sn/Pb Solder  | MSL1 <sup>[1]</sup> | H581<br>XXXX                   |
| HMC581LP6E  | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 <sup>[2]</sup> | H581<br>XXXX                   |

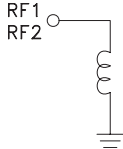

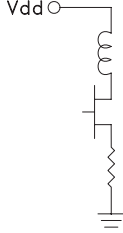
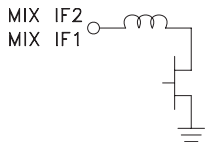
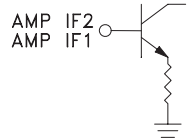
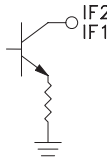
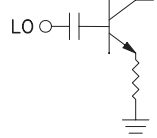
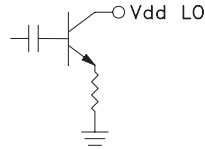
[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

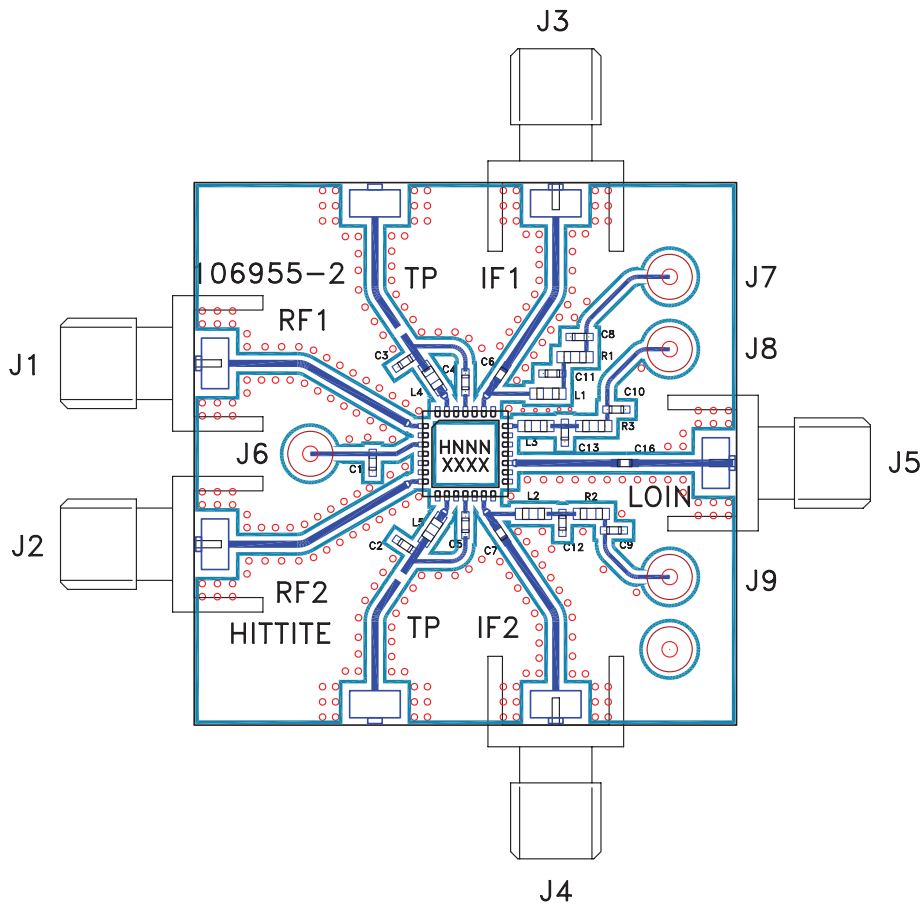
[3] 4-Digit lot number XXXX

For price, delivery, and to place orders, please contact 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)

### Pin Descriptions

| Pin Number   | Function         | Description   | Interface Schematic   |
|--|------------------|---|---|
| 1, 7   | RF1, RF2         | These pins are DC coupled and matched to 50 Ohms.   |    |
| 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28 | GND              | Backside of package has exposed metal ground slug that must also be connected to ground.  |    |
| 3  | Vdd              | Power supply for the second stage LO amplifier. One external bypass capacitor (1,000 pF) is required. 61 mA typical, 73 mA maximum.   |    |
| 5, 15, 19  | N/C              | No connection. These pins may be connected to RF ground. Performance will not be affected.  |   |
| 9, 27  | MIX IF2, MIX IF1 | IF output from the mixers. This pin is DC coupled to the mixer. A low pass filter and blocking capacitor are required between mixer IF port and IF amplifier. (See application circuit).  |  |
| 11, 25   | AMP IF2, AMP IF1 | Inputs to the IF amplifiers. A low pass filter and blocking capacitor are required between mixer IF port and IF amplifier. (See application circuit).   |  |
| 13, 23   | IF2, IF1         | Outputs of the IF amplifiers and bias ports for the IF amplifiers. A pull up inductor, resistor, and bypass capacitors are required. (See application circuit).<br>IF1 = 71 mA typical, 85 mA maximum.<br>IF2 = 71 mA typical, 85 mA maximum. |  |
| 17   | LO               | This pin is AC coupled and matched to 50 Ohms.  |  |
| 21   | Vdd LO           | Bias voltage for the first stage of the LO amplifier. A pull up inductor, resistor, and bypass capacitors are required. (See application circuit). 53 mA typical, 64 mA maximum.  |  |

### Evaluation PCB



### List of Materials for Evaluation PCB 115316 [1]

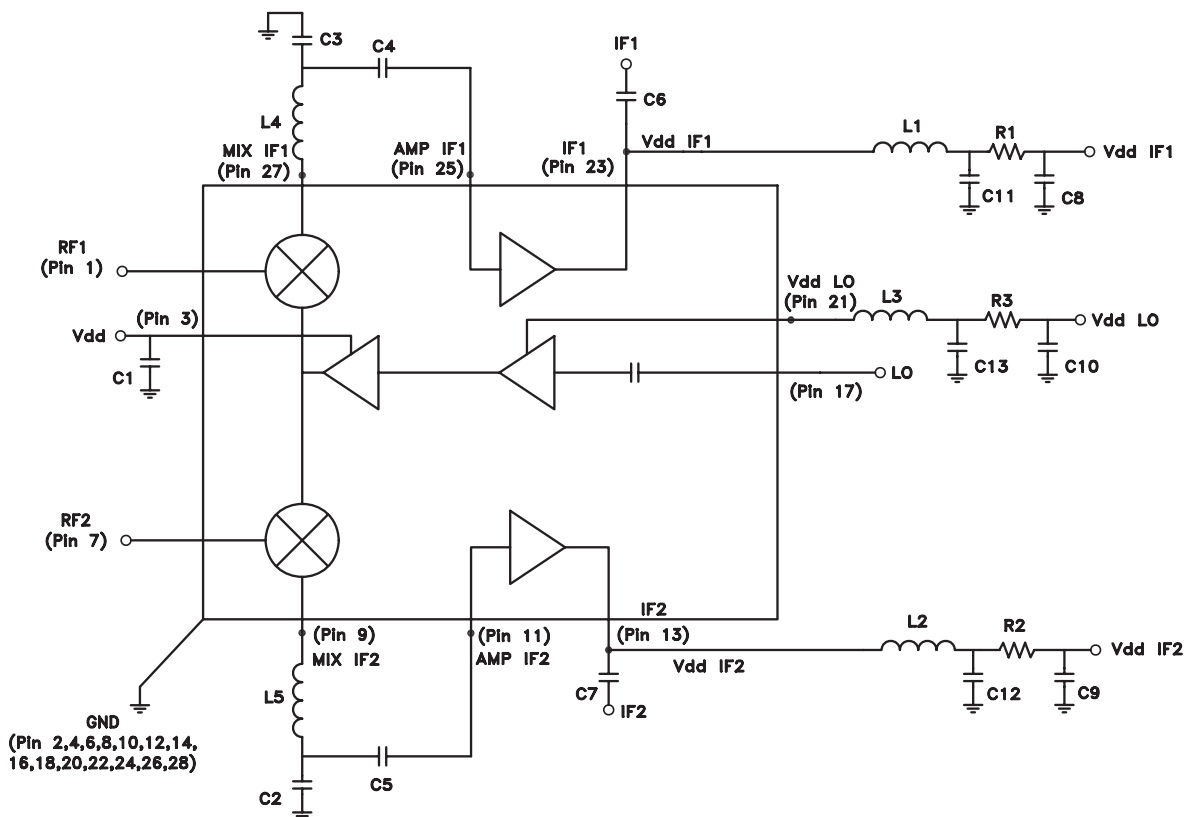
| Item          | Description                       |
|---------------|-----------------------------------|
| J1 - J5       | PCB Mount SMA RF Connector        |
| J6 - J9       | DC Pins                           |
| C1, C4 - C10  | 1000 pF Chip Capacitor, 0402 Pkg. |
| C2, C3        | 7 pF Chip Capacitor, 0402 Pkg.    |
| C11, C12, C13 | 100 pF Chip Capacitor, 0402 Pkg.  |
| L1, L2        | 220 nH Chip Inductor, 0603 Pkg.   |
| L3            | 22 nH Chip Inductor, 0603 Pkg.    |
| L4, L5        | 27 nH Chip Inductor, 0603 Pkg.    |
| R1, R2        | 4.7 Ohm Resistor, 0603 Pkg.       |
| R3            | 22 Ohm Resistor, 0603 Pkg.        |
| U1            | HMC581LP6 / HMC581LP6E            |
| PCB [2]       | 106955-2 Evaluation Board         |

[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 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



| Recommended Components Values (IF = DC - 300 MHz) |         |
|---|---------|
| C1, C4 - C10                                      | 1000 pF |
| C2, C3  | 7 pF    |
| C11, C12, C13                                     | 100 pF  |
| L1, L2  | 220 nH  |
| L3  | 22 nH   |
| L4, L5  | 27 nH   |
| R1, R2  | 4.7 Ohm |
| R3  | 22 Ohm  |

Note: L4, C3 and L5, C2 form low pass filters, these values may be changed for optimization of LO to IF isolation, depending on application frequency. C4 and C5 are DC blocks.