

HIGH IP3 RFIC DUAL DOWNCONVERTER, 1.7 - 2.7 GHz

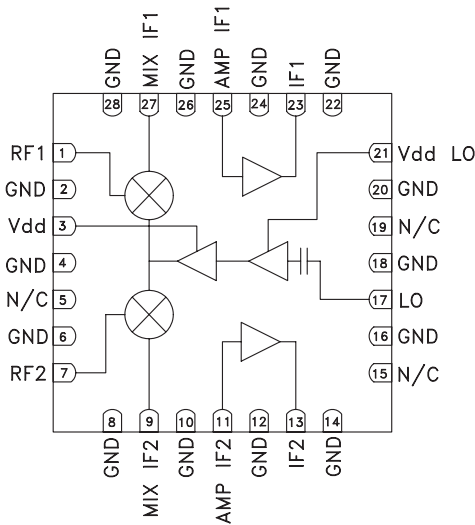


Typical Applications

The HMC381LP6 / HMC381LP6E is ideal for Wireless Infrastructure Applications:

- GSM, GPRS & EDGE
- CDMA & W-CDMA
- PHS & PDC
- WiMAX

Functional Diagram



Features

- Input IP3: +27 dBm
- Low Single Input LO Drive: 0 dBm
- Conversion Gain: 9 dB
- Noise Figure: 12 dB
- Single Positive Supply: +5V @ 260 mA

General Description

The HMC381LP6 & HMC381LP6E are high linearity Dual Down Converter Receiver ICs that operate from 1.7 - 2.7 GHz and deliver a +27 dBm input third order intercept point for UMTS, PHS and WiMAX 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 12 dB typical single side band noise figure. The IC operates from a positive +5V rail consuming 260 mA of current while requiring a LO drive level of only -4 to +4 dBm. The design requires no external baluns and supports IF frequencies between 50 and 300 MHz.

Electrical Specifications, $T_A = +25^\circ C$, LO = 0 dBm, Vdd = 5V

| Parameter | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | Units |
|--|-------------------------|------|------|-------------------------|------|------|-------------------------|------|------|-------|
| Frequency Range, RF | 1.7 - 2.0 | | | 2.0 - 2.2 | | | 2.5 - 2.7 | | | GHz |
| Frequency Range, LO | 1.4 - 2.3 | | | 1.7 - 2.5 | | | 2.2 - 2.6 | | | GHz |
| Frequency Range, IF | 50 - 300 ^[1] | | | 50 - 300 ^[1] | | | 50 - 300 ^[2] | | | MHz |
| Conversion Gain | 6.5 | 8.5 | | 7 | 9 | | 7 | 9 | | dB |
| Noise Figure (SSB) | | 12 | | | 12.5 | | | | | dB |
| LO to RF Isolation | | 11 | | | 11 | | | 5 | | dB |
| LO to IF Isolation | 16 | 20 | | 14 | 18 | | 13 | 18 | | dB |
| RF to IF Isolation | 30 | 40 | | 40 | 46 | | 32 | 37 | | dB |
| IP3 (Input) | 23 | 26 | | 24 | 27 | | 23 | 26 | | dBm |
| 1 dB Compression (Input) | | 12 | | | 12 | | | 10 | | dBm |
| Branch Isolation | | 50 | | | 52 | | | 50 | | dB |
| LO Drive Input Level (Typical) | -4 to +4 | | | | | | | | | dBm |
| Supply Current (I _{dd} for LO & IF) (IF bias resistor= 4.7 Ohms) | | 260 | 330 | | 260 | 330 | | 260 | 330 | mA |

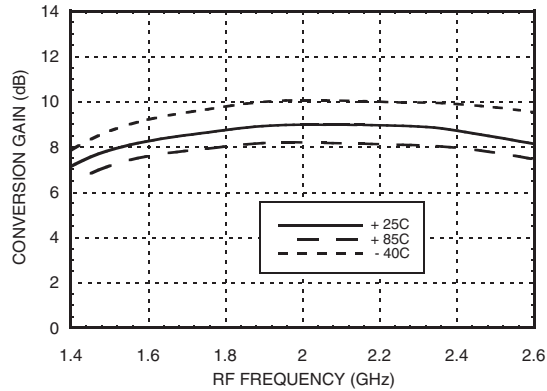
[1] Unless otherwise noted all measurements with low side LO & IF = 250 MHz.

[2] Unless otherwise noted all measurements with low side LO & IF = 156 MHz.

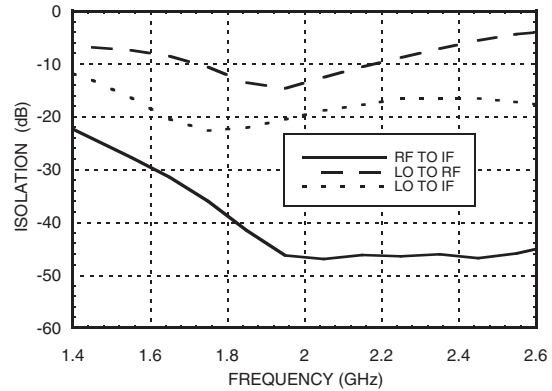
**HIGH IP3 RFIC DUAL
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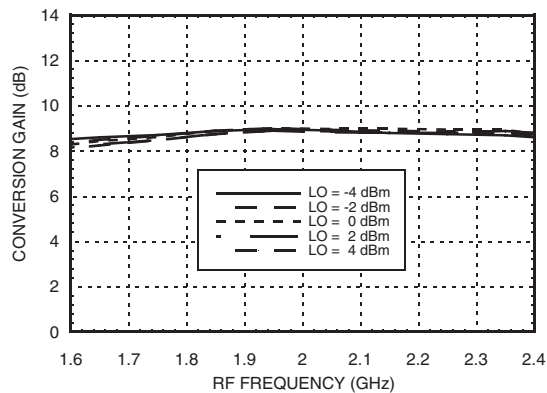
**Conversion Gain
 vs. Temperature @ LO = 0 dBm**



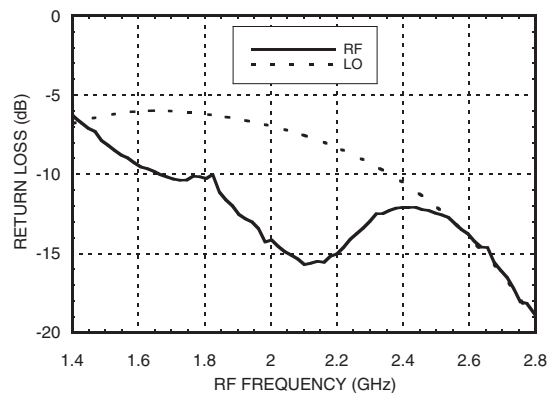
Isolation @ LO = 0 dBm



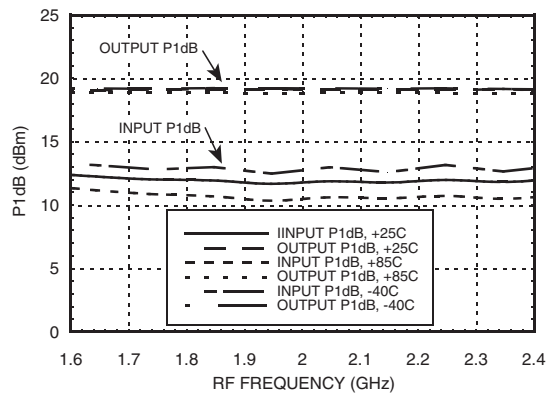
Conversion Gain vs. LO Drive



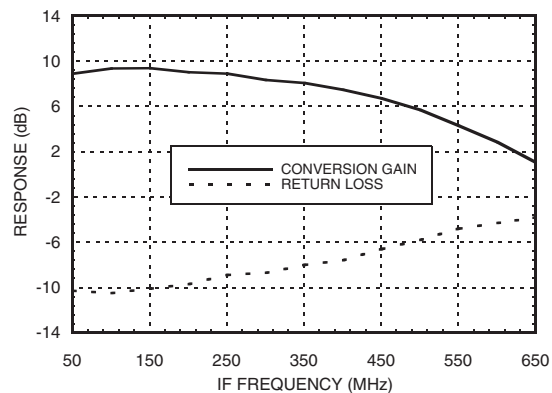
Return Loss @ LO = 0 dBm



P1dB vs. Temperature @ LO = 0 dBm



IF Bandwidth @ LO = -5 dBm

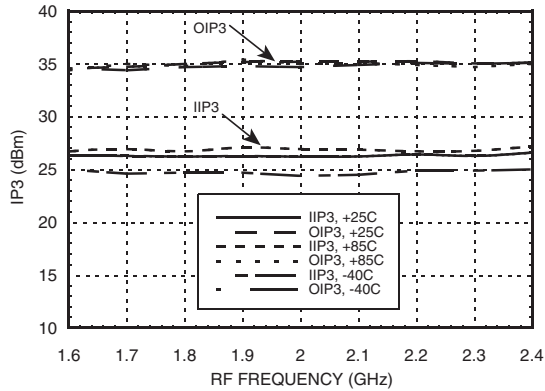




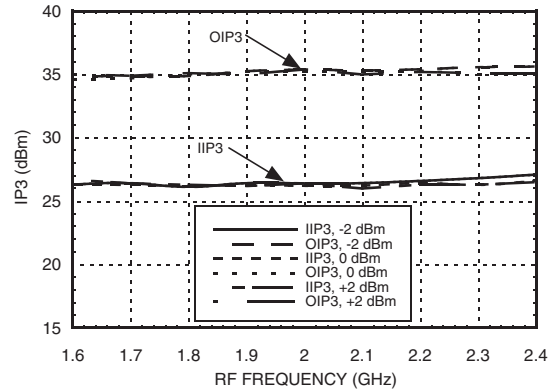
HMC381LP6 / 381LP6E

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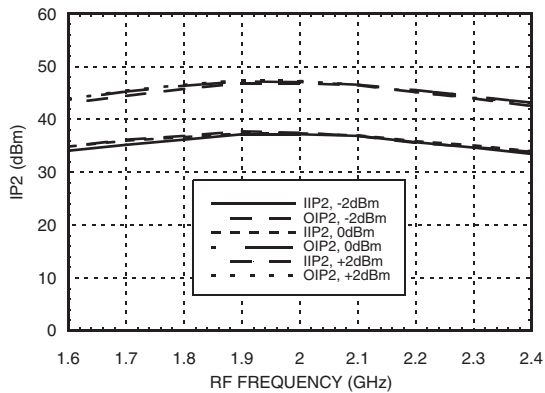
**Input and Output IP3
vs. Temperature @ LO = 0 dBm**



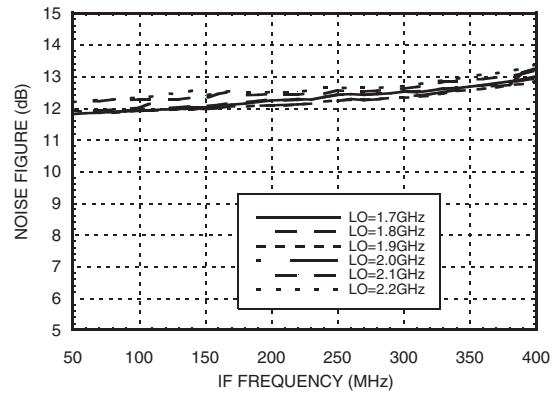
Input and Output IP3 vs LO Drive



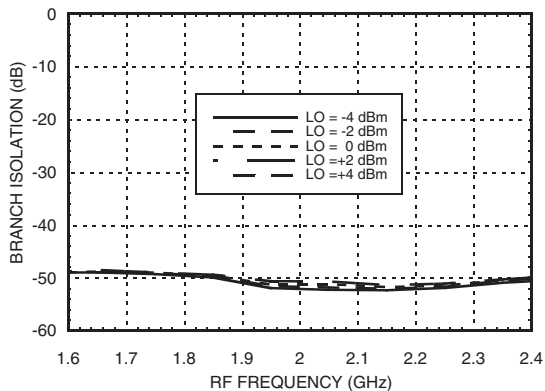
Input and Output IP2 vs. LO Drive



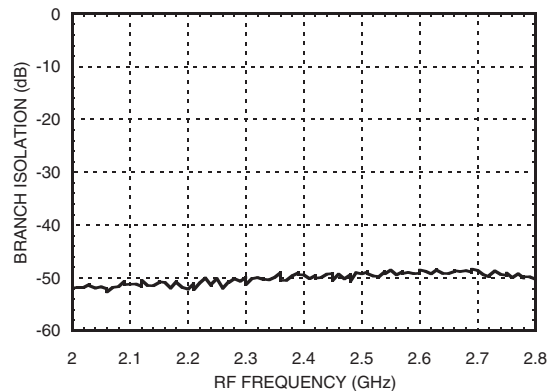
Noise Figure vs. IF Frequency



**Branch Isolation RF1 - IF2 vs. LO Drive
IF = 250 MHz**



**Branch Isolation RF1 - IF2
LO = 0 dBm, IF = 156 MHz**



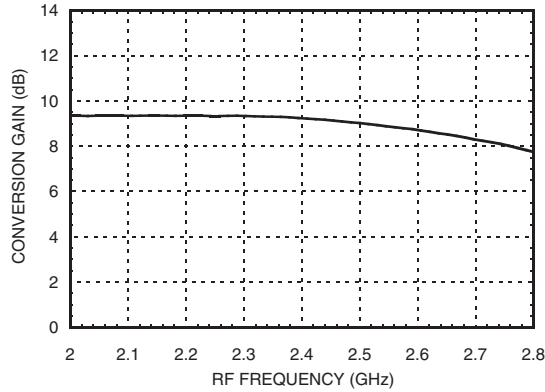
Reference to output of standard path



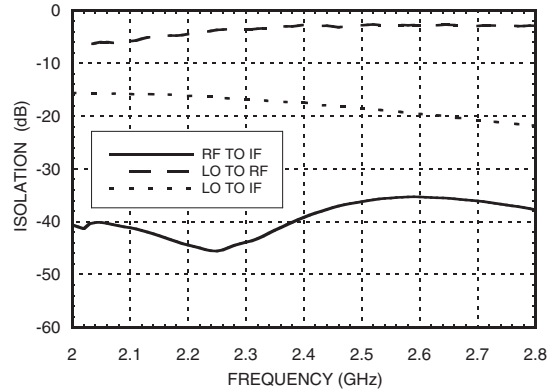
HMC381LP6 / 381LP6E

HIGH IP3 RFIC DUAL DOWNCONVERTER, 1.7 - 2.7 GHz

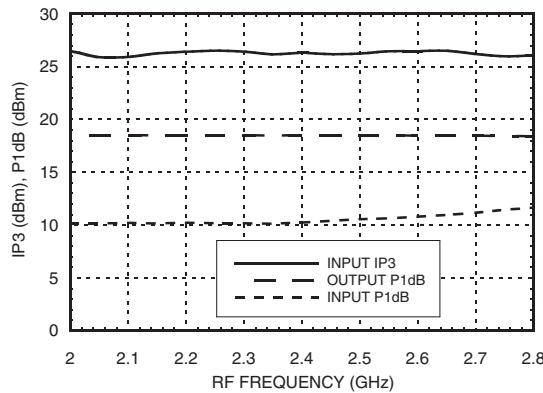
Conversion Gain @ LO = 0 dBm
IF = 156 MHz



Isolation @ LO = 0 dBm, IF = 156 MHz



Input IP3 & Input P1dB
@ LO = 0 dBm, IF = 156 MHz



MxN Spurious @ IF Port

| mRF | nLO | | | | |
|-----|-----|----|----|----|----|
| | 0 | 1 | 2 | 3 | 4 |
| 0 | xx | 21 | 52 | 40 | 48 |
| 1 | 54 | 0 | 57 | 82 | 88 |
| 2 | 95 | 79 | 53 | 84 | 94 |
| 3 | 94 | 94 | 95 | 72 | 95 |
| 4 | 94 | 95 | 94 | 95 | 95 |

RF Freq. = 1.9 GHz @ -10 dBm
LO Freq. = 1.65 GHz @ 0 dBm
All values in dBc relative to the IF power level.

Harmonics of LO

| LO Freq. (GHz) | nLO Spur @ RF Port | | | |
|----------------|--------------------|----|----|----|
| | 1 | 2 | 3 | 4 |
| 1.4 | 8 | 12 | 15 | 19 |
| 1.5 | 9 | 13 | 16 | 21 |
| 1.6 | 11 | 14 | 17 | 24 |
| 1.7 | 13 | 15 | 18 | 29 |
| 1.8 | 12 | 13 | 19 | 29 |
| 1.9 | 11 | 12 | 19 | 28 |

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

HMC381LP6 / 381LP6E

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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 _{diss} (T = 85°C) (derate 25.5 mW/°C above 85°C) | 1.64 W |
| Thermal Resistance (junction to ground paddle) | 39.6 °C/W |
| Storage Temperature | -65 to +150°C |
| Operating Temperature | -40 to +85°C |
| ESD Sensitivity (HBM) | Class 1A |

Typical Supply Current vs. Vdd

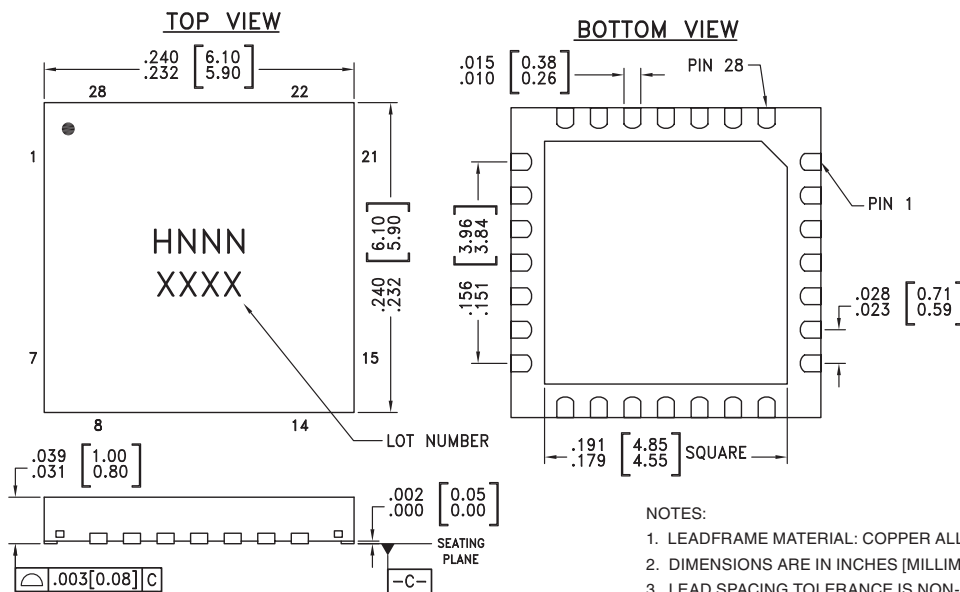
| Vdd (LO + IF) | I _{dd} (mA) |
|---------------|----------------------|
| +4.5 | 190 |
| +5.0 | 260 |
| +5.5 | 340 |

Downconverter will operate over full voltage range shown above.



**ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS**

Outline Drawing



NOTES:

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

Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[3] |
|-------------|---|---------------|---------------------|--------------------------------|
| HMC381LP6 | Low Stress Injection Molding Plastic | Sn/Pb Solder | MSL1 ^[1] | H381 XXXX |
| HMC381LP6E | RoHS-compliant Low Stress Injection Molding Plastic | 100% matte Sn | MSL1 ^[2] | H381 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:

SUNSTAR 微波光电 <http://www.hittite.com> / TEL:0755-83396822 FAX:0755-83376182 E-MAIL: szss20@163.com

Order On-line at www.hittite.com

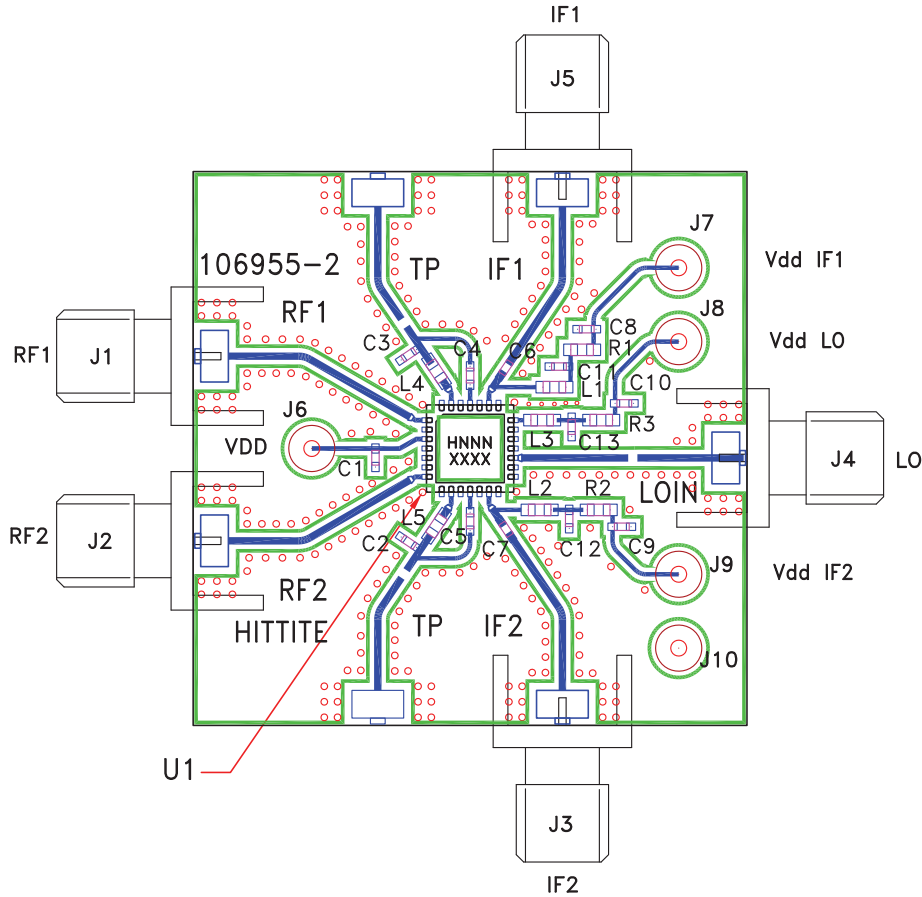


Pin Descriptions

| 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. | |
| 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). | |
| 17 | LO | These pins are 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). | |



Evaluation PCB



List of Materials for Evaluation PCB 106971 [1]

| Item | Description |
|---------------|-----------------------------------|
| J1 - J5 | PCB Mount SMA RF Connector |
| J6 - J10 | 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 | HMC381LP6 / HMC381LP6E |
| PCB [2] | 106955 Evaluation Board |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

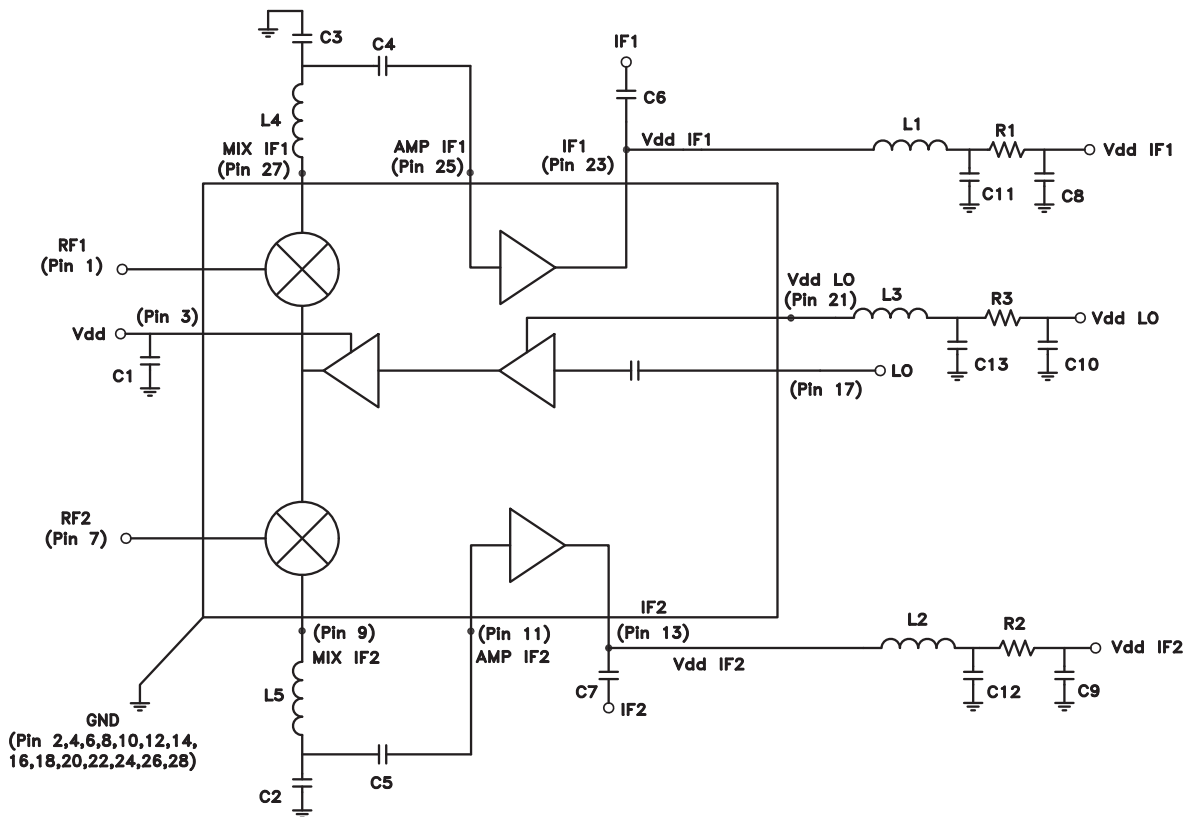
The circuit board used in the final application should use RF circuit design techniques. Signal lines should have 50 ohm impedance while the package ground leads and exposed paddle should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used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

For price, delivery, and to place orders, please contact Hittite Microwave Corporation:

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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. C4 and C5 are DC blocks.