# HMC380QS16G / 380QS16GE

v02.0305

## PCS/UMTS HIGH IP3 RFIC DOWNCONVERTER, 1.7 - 2.2 GHz

### Typical Applications

The HMC380QS16G / HMC380QS16GE is ideal for:

- GSM, GPRS & EDGE Infrastructure
- CDMA, WCDMA Infrastructure
- PHS Infrastructure

### Features

+19 dBm Input IP3

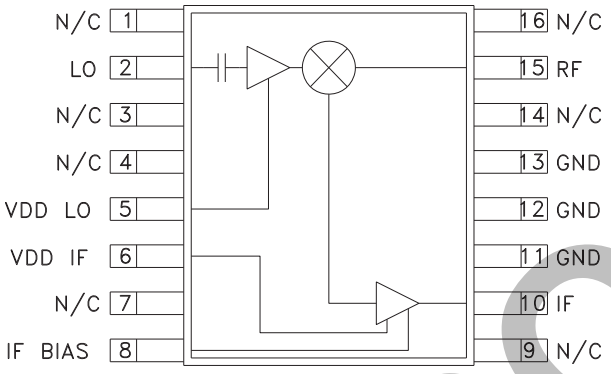
Low LO Drive: -5 dBm

Conversion Gain: 11 dB

Noise Figure: 9 dB

Single Positive Supply: +5V, 165 mA

### Functional Diagram




### General Description

The HMC380QS16G & HMC380QS16GE are high linearity down-converter receiver ICs suitable for PCS/UMTS infrastructure applications from 1.7 - 2.2 GHz. The receiver IC is designed to support UMTS applications where a high third order intercept point is required. A passive mixer coupled with a high dynamic range IF amplifier achieves an input IP3 of +19 dBm. The converter provides a gain of 11.5 dB and 9 dB typical single side band noise figure. The IC operates from a positive +5V rail consuming 165 mA of current while only requiring a -5 dBm LO drive. The design requires no external baluns. The mixer supports IF frequencies between 50 MHz and 300 MHz.



### Electrical Specifications, $T_A$ = +25° C, LO = -5 dBm, Vdd = 5V, IF = 250 MHz [1]

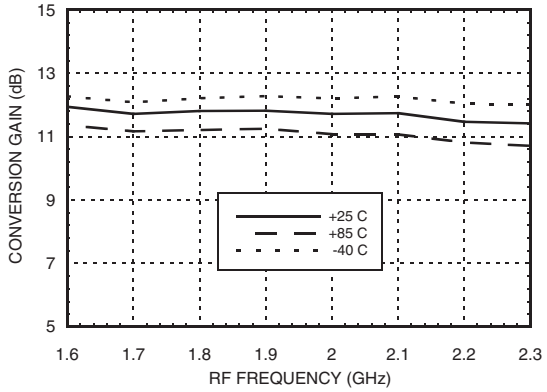
| Parameter | Min. | Typ. | Max. | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| Frequency Range, RF | | 1.7 - 2.0 | | | 2.0 - 2.2 | | GHz |
| Frequency Range, LO | | 1.4 - 1.95 | | | 1.7 - 2.15 | | GHz |
| Frequency Range, IF [2] | | 50 - 300 | | | 50 - 300 | | MHz |
| Conversion Gain | 9 | 11.5 | | 9 | 11.5 | | dB |
| Noise Figure (SSB) | | 9.2 | 10.5 | | 10 | 11.5 | dB |
| LO to RF Isolation | 20 | 25 | | 23 | 28 | | dB |
| LO to IF Isolation | 22 | 32 | | 30 | 38 | | dB |
| RF to IF Isolation | 38 | 50 | | 46 | 54 | | dB |
| IP3 (Input) | 17 | 19 | | 17 | 19 | | dBm |
| 1 dB Compression (Input) | 3 | 5 | | 3 | 6 | | dBm |
| LO Input Drive Level (Typical) | | -5 to 0 | | | -5 to 0 | | dBm |
| Supply Current (Idd for LO & IF)<br>(IF bias resistor= 3.3 Ohms) | | 175 | | | 175 | | mA |

[1] Unless otherwise noted all measurements with low side LO & IF = 250 MHz.
[2] If matching must be tuned for optimal results, see application circuit herein.

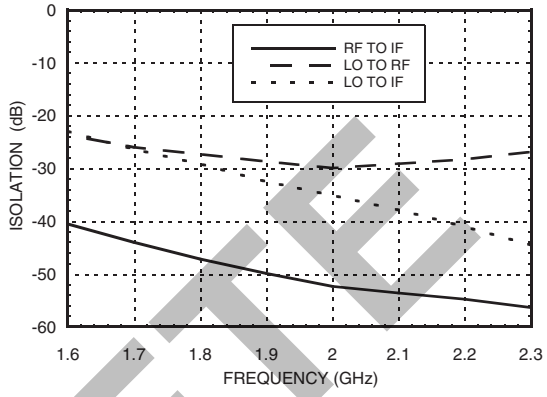


*For price, delivery, and to place orders: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106*
*Phone: 781-329-4700 • Order online at www.analog.com*
*Application Support: Phone: 1-800-ANALOG-D*

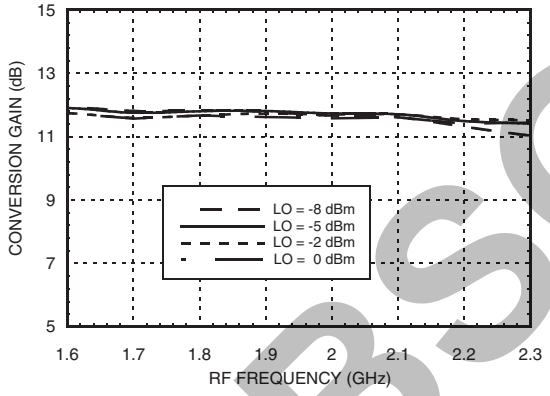
### Conversion Gain vs. Temperature



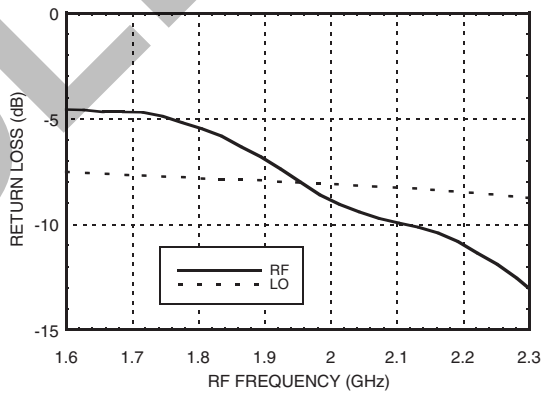

### Isolation



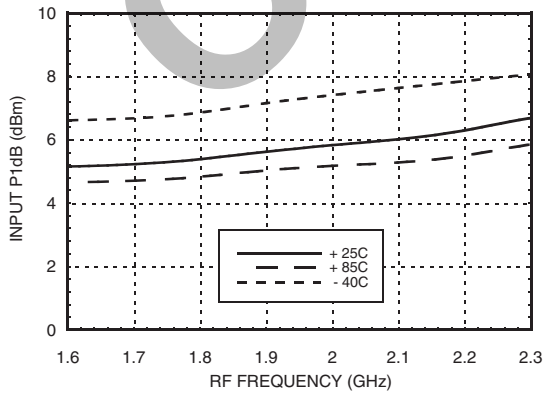

### Conversion Gain vs. LO Drive



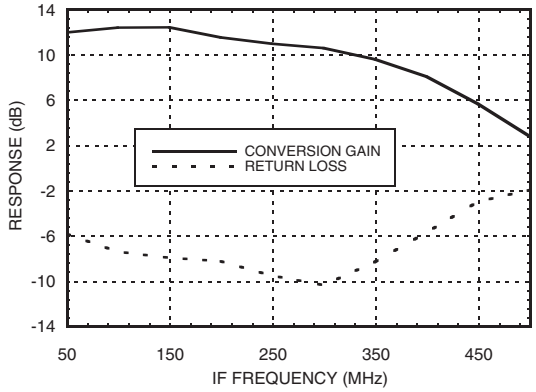

### Return Loss




### Input P1dB vs. Temperature




### IF Bandwidth




** Unless otherwise noted all measurements with low side LO & IF = 250 MHz.*
*** If matching must be tuned for optimal results, see application circuit herein.*

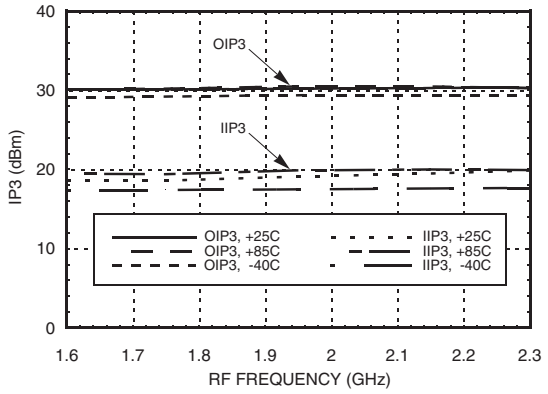


*For price, delivery, and to place orders: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106*
*Phone: 781-329-4700 • Order online at www.analog.com*
*Application Support: Phone: 1-800-ANALOG-D*

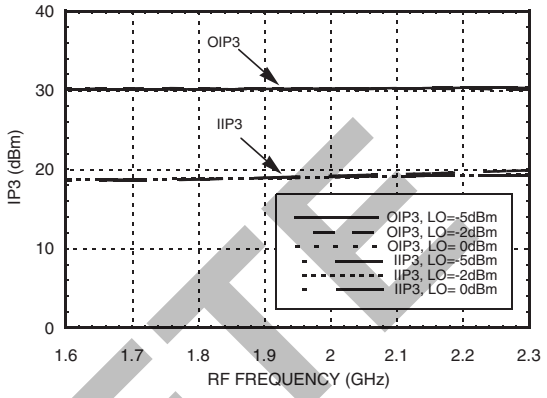
RoHS✓ EARTH FRIENDLY

## PCS/UMTS HIGH IP3 RFIC DOWNCONVERTER, 1.7 - 2.2 GHz

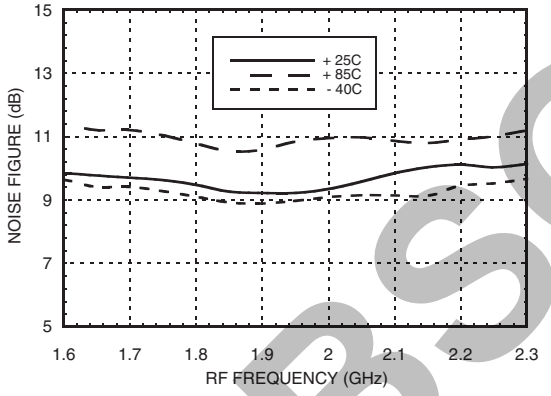
### Input and Output IP3 vs. Temperature



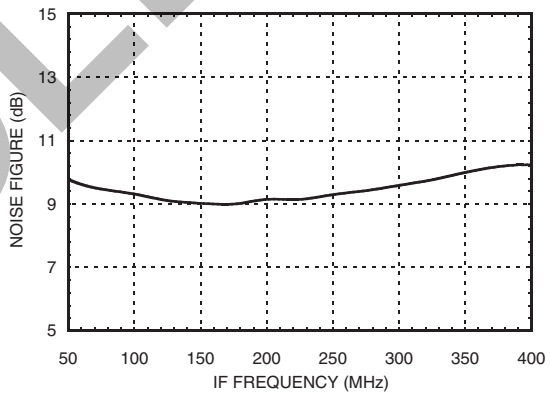

### Input and Output IP3 vs LO Drive



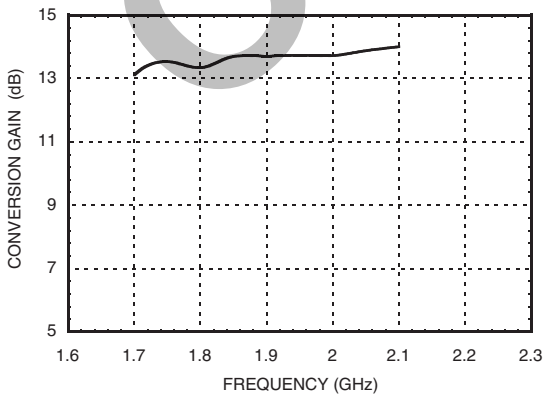

### Noise Figure vs Temperature Swept LO, Fixed IF = 250 MHz



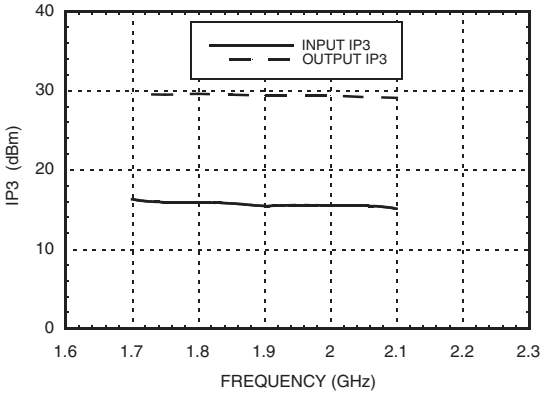

### Noise Figure Swept IF, Fixed LO = 1.7 GHz




### Conversion Gain with IF Tuned for 70 MHz




### IP3 with IF Tuned for 70 MHz






** Unless otherwise noted all measurements with low side LO & IF = 250 MHz.*
*** If matching must be tuned for optimal results, see application circuit herein.*



*For price, delivery, and to place orders: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106*
*Phone: 781-329-4700 • Order online at www.analog.com*
*Application Support: Phone: 1-800-ANALOG-D*

RoHS✓ EARTH FRIENDLY

## PCS/UMTS HIGH IP3 RFIC DOWNCONVERTER, 1.7 - 2.2 GHz

### MxN Spurious @ IF Port

| | nLO | | | | |
|---|---|---|---|---|---|
| mRF | 0 | 1 | 2 | 3 | 4 |
| 0 | xx | 40 | 60 | 58 | 35 |
| 1 | 62 | 0 | 62 | 87 | 102 |
| 2 | 124 | 101 | 55 | 94 | 110 |
| 3 | 126 | 126 | 113 | 76 | 112 |
| 4 | 121 | 127 | 128 | 124 | 116 |

RF Freq. = 1.9 GHz @ -10 dBm
LO Freq. = 1.65 GHz @ -5 dBm
All values in dBc relative to the IF power level.

### Harmonics of LO

| | nLO Spur @ RF Port | | | |
|---|---|---|---|---|
| LO Freq. (GHz) | 1 | 2 | 3 | 4 |
| 1.4 | 23 | 3 | 16 | 15 |
| 1.6 | 26 | 6 | 12 | 18 |
| 1.8 | 26 | 8 | 10 | 29 |
| 2.0 | 24 | 8 | 12 | 31 |
| 2.2 | 38 | 10 | 14 | 35 |
| 2.4 | 23 | 12 | 19 | 40 |

LO = -5 dBm
All values in dBc below input LO level measured at RF port.







*For price, delivery, and to place orders: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106*
*Phone: 781-329-4700 • Order online at www.analog.com*
*Application Support: Phone: 1-800-ANALOG-D*

# HMC380QS16G / 380QS16GE

v02.0305

## PCS/UMTS HIGH IP3 RFIC DOWNCONVERTER, 1.7 - 2.2 GHz

### Absolute Maximum Ratings

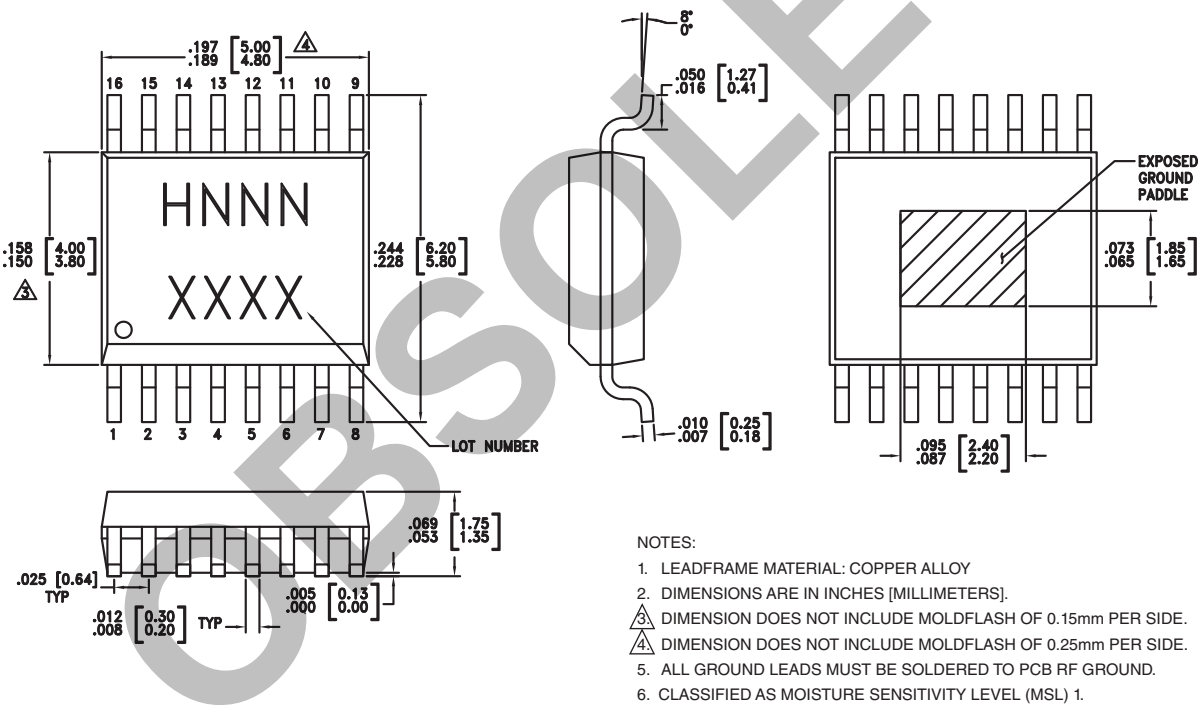
| | |
|---|---|
| RF / IF Input (Vdd= +5V) | +13 dBm |
| LO Drive (Vdd= +5V) | +15 dBm |
| Vdd (LO or IF) | +7 Vdc |
| Channel Temperature | 150°C |
| Continuous Pdiss (T = 85°C) (derate 17 mW/°C above 85°C) | 1.10 W |
| Thermal Resistance (channel to ground paddle) | 59 °C/W |
| Storage Temperature | -65 to +150°C |
| Operating Temperature | -40 to +85°C |

### Typical Supply Current vs. Vdd

| Vdd (LO + IF) | Idd (mA) |
|---|---|
| +4.5 | 162 |
| +5.0 | 165 |
| +5.5 | 168 |
| Downconverter will operate over full voltage range shown above. | |

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

### Outline Drawing




NOTES:

1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS].
3. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
4. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
5. ALL GROUND LEADS MUST BE SOLDERED TO PCB RF GROUND.
6. CLASSIFIED AS MOISTURE SENSITIVITY LEVEL (MSL) 1.



### Package Information

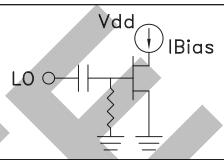
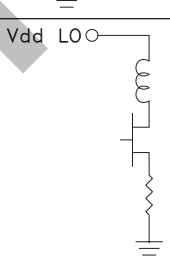
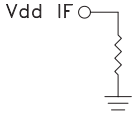
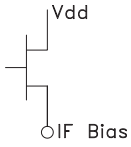
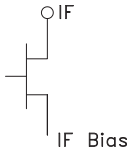
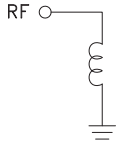
| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking [3] |
|---|---|---|---|---|
| HMC380QS16G | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 [1] | H380<br>XXXX |
| HMC380QS16GE | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 [2] | H380<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: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106*
*Phone: 781-329-4700 • Order online at www.analog.com*
*Application Support: Phone: 1-800-ANALOG-D*

## Pin Descriptions

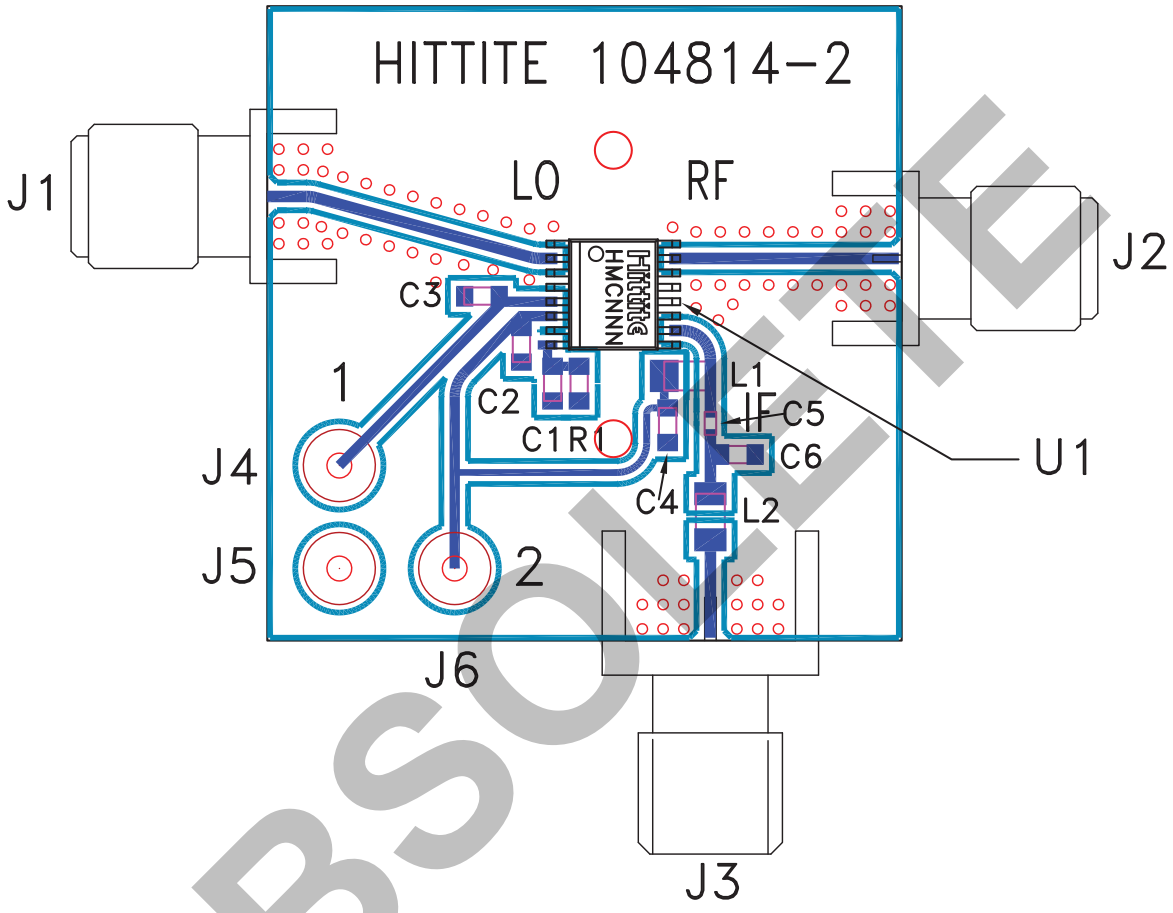
| Pin Number | Function | Description | Interface Schematic |
|---|---|---|---|
| 1, 3, 4, 7, 9, 14, 16 | N/C | Not Connected | |
| 2 | LO | This pin is AC coupled and matched to 50 Ohm from 1.4 - 2.2 GHz. |   |
| 11, 12, 13 | GND | Backside of package has exposed metal ground slug that must also be connected to RF/DC ground. |   |
| 5 | Vdd LO | Power supply for the LO amplifier. One external RF bypass capacitor (10,000 pF) is required. |   |
| 6 | Vdd IF | Bias voltage for IF amplifier. One external RF bypass capacitor (10,000 pF) is required. |   |
| 8 | IF Bias | DC bias setting for IF amplifier. |   |
| 10 | IF | Output of IF and bias port for amplifier. A pull up inductor (L1), output matching network (C5, C6, L2), and 10,000 pF bypass capacitor (C4) are required. |   |
| 15 | RF | This pin is DC coupled and matched to 50 Ohm from 1.7 - 2.2 GHz. |   |





*For price, delivery, and to place orders: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106*
*Phone: 781-329-4700 • Order online at www.analog.com*
*Application Support: Phone: 1-800-ANALOG-D*

## Evaluation PCB






## List of Materials for Evaluation PCB 106397 [1]

| Item | Description |
|---|---|
| J1 - J3 | PC Mount SMA RF Connector |
| J4 - J6 | DC Pins |
| C1 | 1000 pF Chip Capacitor, 0603 Pkg. |
| C2, C3, C4 | 0.01µF Chip Capacitor, 0603 Pkg. |
| C5 | 82 pF Chip Capacitor, 0402 Pkg. |
| C6 | 6 pF Chip Capacitor, 0603 Pkg. |
| L1 | 150 nH Chip Inductor, 0805 Pkg. |
| L2 | 27 nH Chip Inductor, 0805 Pkg. |
| R1 | 3.3 Ohm Resistor, 0603 Pkg. |
| U1 | HMC380QS16G / HMC380QS16GE |
| PCB [2] | 104814 Evaluation Board, 1.100" x 1.100" |

[1] Reference this number when ordering complete evaluation PCB

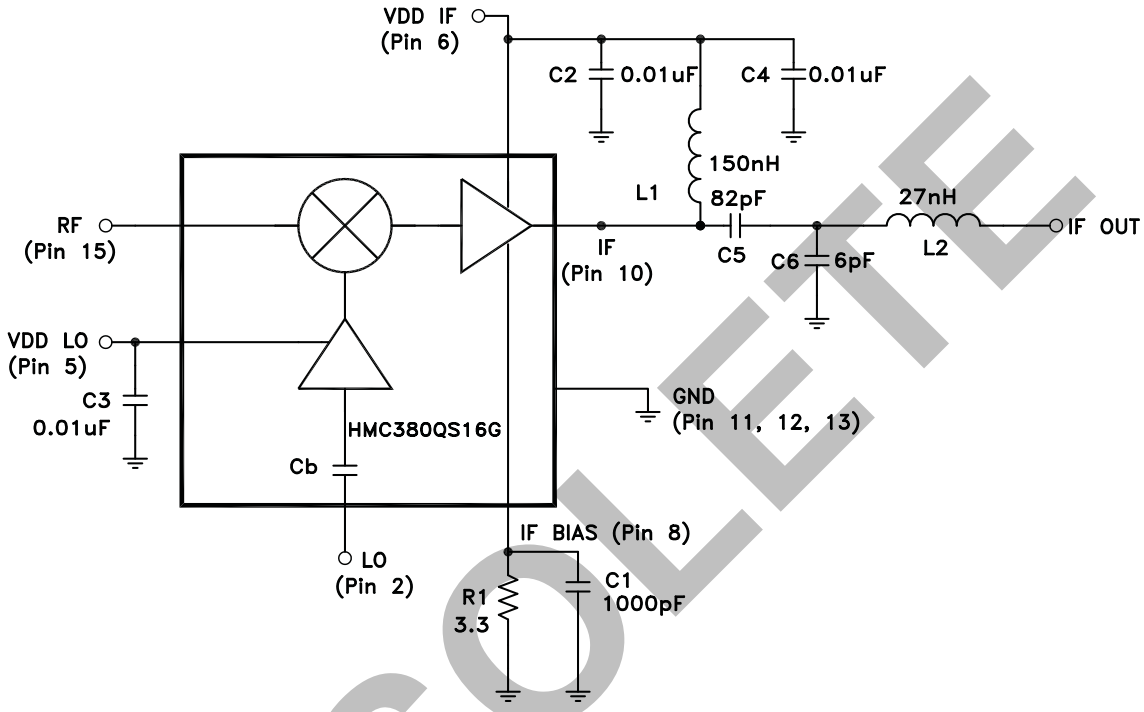
[2] Circuit Board Material: Rogers 4350

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: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106*
*Phone: 781-329-4700 • Order online at www.analog.com*
*Application Support: Phone: 1-800-ANALOG-D*

## Application Circuit




Note: Pin 5 and Pin 6 may be connected to a common Vdd Supply.



## Selection of L2 & C6 For Various Tuned IF Frequencies*

| IF | L2 | C6 |
|---|---|---|
| 250 MHz | 27 nH | 6 pF |
| 70 MHz | 39 nH | 39 pF |

** Contact Hittite to optimize tuning topology for desired IF frequency.*

** Unless otherwise noted all measurements with low side LO & IF = 250 MHz.*
*** If matching must be tuned for optimal results, see application circuit herein.*



*For price, delivery, and to place orders: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106*
*Phone: 781-329-4700 • Order online at www.analog.com*
*Application Support: Phone: 1-800-ANALOG-D*