

# Analog Devices Welcomes Hittite Microwave Corporation

NO CONTENT ON THE ATTACHED DOCUMENT HAS CHANGED



**THIS PAGE INTENTIONALLY LEFT BLANK**



### Typical Applications

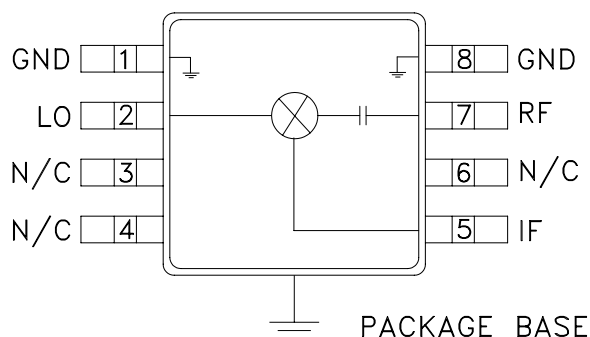
The HMC412MS8G / HMC412MS8GE is ideal for:

- Long Haul Radio Platforms
- Microwave Radio
- VSAT

### Features

Conversion Loss: 8 dB  
 Noise Figure: 8 dB  
 Input IP3: 17 dBm  
 No External Components  
 MSOP8G SMT Package

### Functional Diagram



### General Description

The HMC412MS8G & HMC412MS8GE are passive double balanced mixers that operate between 9.0 GHz and 15 GHz. The HMC412MS8G(E) operate with LO drive levels between +9 dBm and +13 dBm, and provides 8 dB conversion loss across the entire specified frequency band. This mixer requires no external components or bias.

### Electrical Specifications, $T_A = +25^\circ \text{C}$

Parameter	IF = 1.45 GHz LO = +13 dBm			Units
	Min.	Typ.	Max.	
Frequency Range, RF & LO	9.0 - 15.0			GHz
Frequency Range, IF	DC - 2.5			GHz
Conversion Loss		8	11	dB
Noise Figure (SSB)		8	11	dB
LO to RF Isolation	30	40 - 50		dB
LO to IF Isolation	33	40 - 50		dB
RF to IF Isolation	8	17		dB
IP3 (Input)	14	17		dBm
1 dB Compression (Input)	7	9.5		dBm

\* Unless otherwise noted, all measurements performed as downconverter, IF= 1.45 GHz.

For price, delivery and to place orders: Hittite Microwave Corporation, 2 Elizabeth Drive, Chelmsford, MA 01824

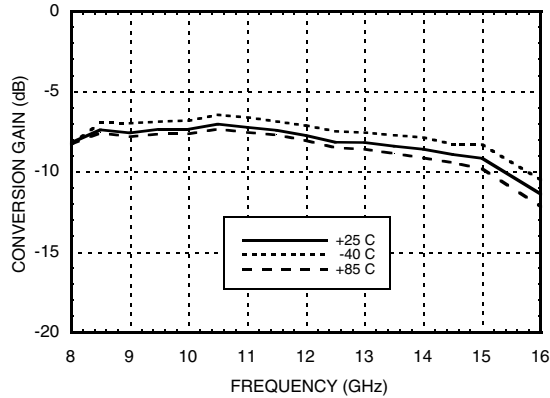
Phone: 978-250-3343 Fax: 978-250-3373 Order On-line at [www.hittite.com](http://www.hittite.com)

Application Support: Phone: 978-250-3343 or [apps@hittite.com](mailto:apps@hittite.com)

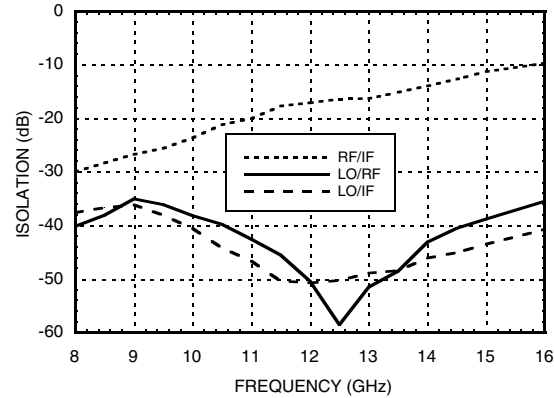


**DOUBLE-BALANCED  
MIXER, 9 - 15 GHz**

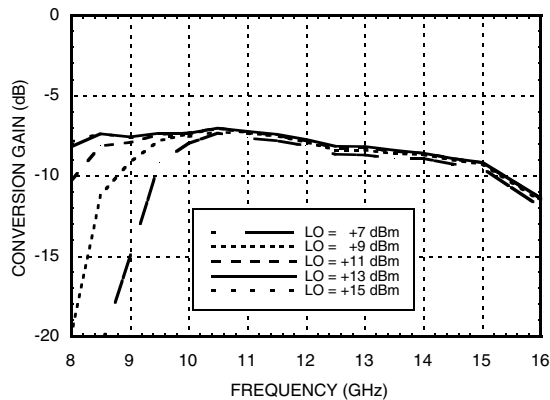
**Conversion Gain vs.  
Temperature @ LO = +13 dBm**



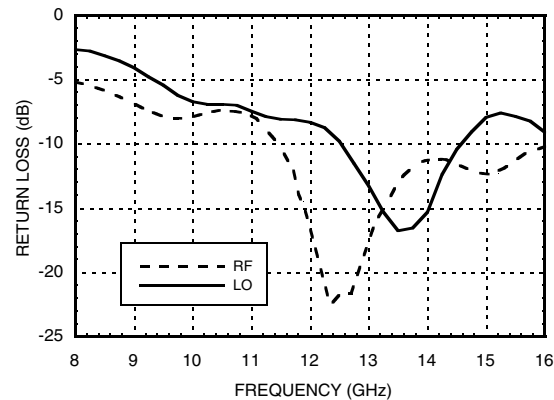
**Isolation @ LO = +13 dBm**



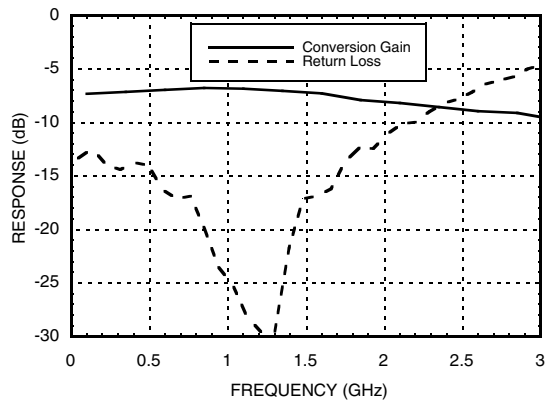
**Conversion Gain vs. LO Drive**



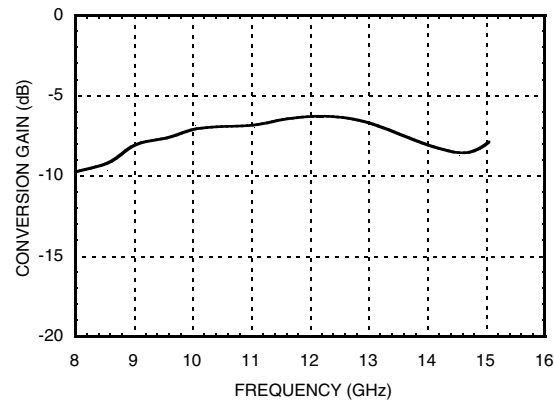
**Return Loss @ LO = +13 dBm**



**IF Bandwidth @ LO = +13 dBm**

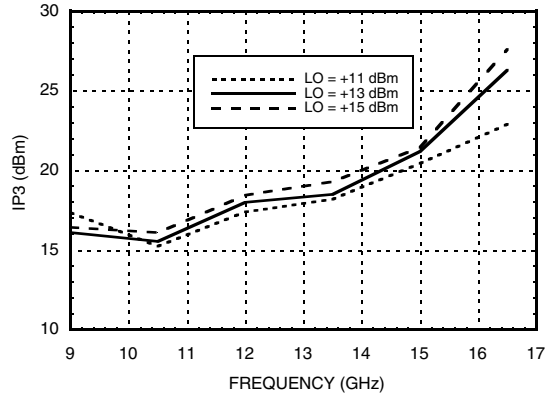


**Upconverter Performance  
Conversion Gain @ LO = +13 dBm**

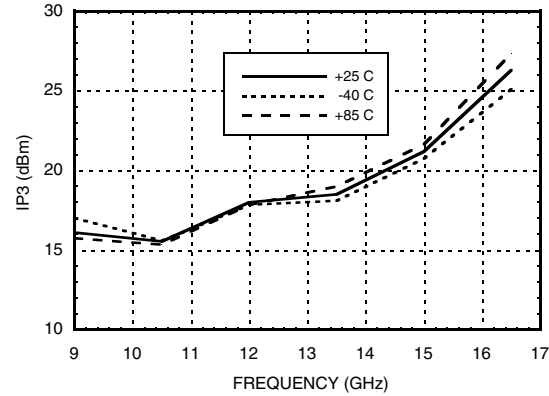




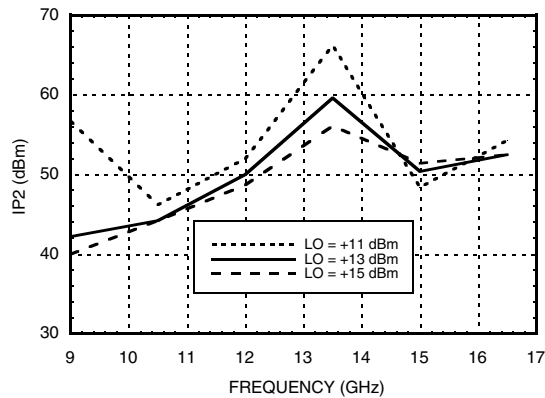
**Input IP3 vs. LO Drive\***



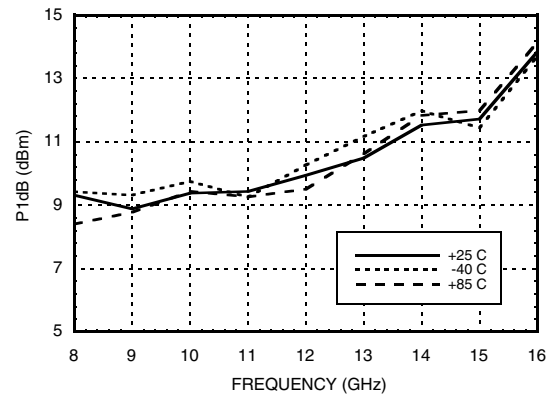
**Input IP3 vs. Temperature @ LO = +13 dBm\***



**Input IP2 vs. LO Drive \***



**Input P1dB vs. Temperature @ LO = +13 dBm**



**MxN Spurious @ IF Port**

mRF	nLO				
	0	1	2	3	4
0	XX	16	27	38	N/A
1	7	0	>85	57	56
2	78	>85	72	71	>85
3	>85	>85	>85	78	>85
4	N/A	>85	>85	>85	>85

RF = 14.45 GHz @ -10 dBm  
 LO = 13 GHz @ +13 dBm  
 All values in dBc relative to the IF.  
 Measured as downconverter.

**Harmonics of LO**

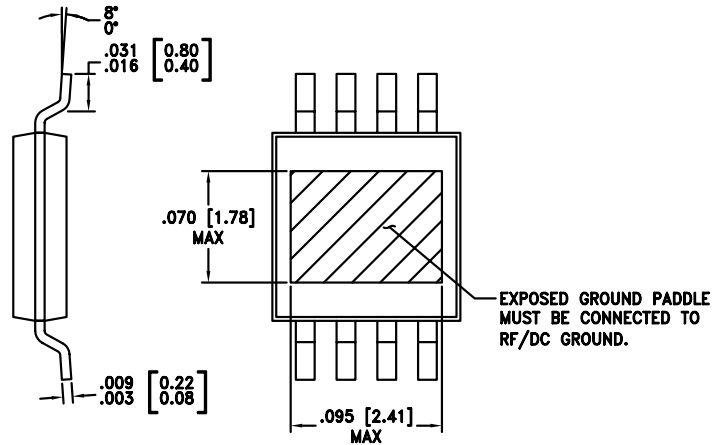
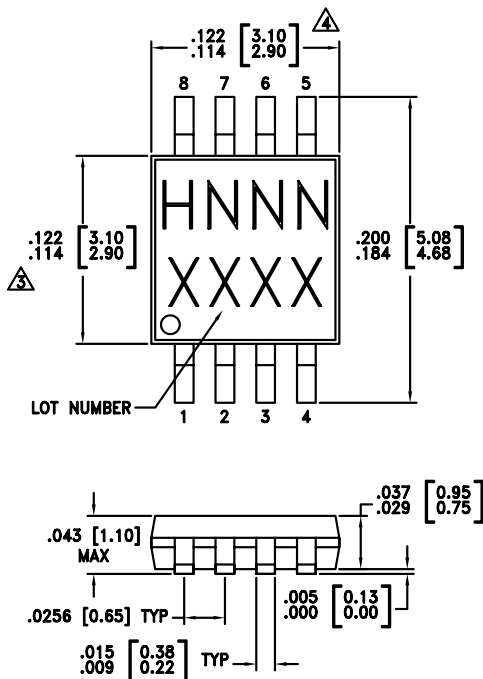
LO Freq. (GHz)	nLO Spur @ RF Port			
	1	2	3	4
9	36	30	58.3	70.5
10.5	34.8	31.3	35.7	57.5
12	49.5	44.5	65.2	68.7
13.5	48.7	58.8	69	N/A
15	39.2	74.5	64	N/A
16.5	34	61.3	60.3	N/A

LO = +13 dBm  
 All values in dBc below input LO level @ RF port.

\* Two-tone input power = -10 dBm each tone, 1 MHz spacing.

**Absolute Maximum Ratings**

RF / IF Input (Vdd = +3V)	+27 dBm
LO Drive (Vdd = +3V)	+27 dBm
IF DC Current	±4 mA
Storage Temperature	-65 to +150 °C
Operating Temperature	-55 to +85 °C
ESD Sensitivity (HBM)	Class 1A


**ELECTROSTATIC SENSITIVE DEVICE**  
**OBSERVE HANDLING PRECAUTIONS**
**Outline Drawing**

**NOTES:**

- LEADFRAME MATERIAL: COPPER ALLOY
- DIMENSIONS ARE IN INCHES [MILLIMETERS].
- $\triangle$  DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
- $\triangle$  DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
- ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.

**Package Information**

Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking <sup>[3]</sup>
HMC412MS8G	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL1 <sup>[1]</sup>	H412 XXXX
HMC412MS8GE	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 <sup>[2]</sup>	H412 XXXX

[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX


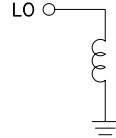
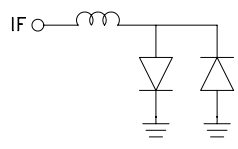
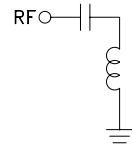
For price, delivery and to place orders: Hittite Microwave Corporation, 2 Elizabeth Drive, Chelmsford, MA 01824

Phone: 978-250-3343 Fax: 978-250-3373 Order On-line at [www.hittite.com](http://www.hittite.com)

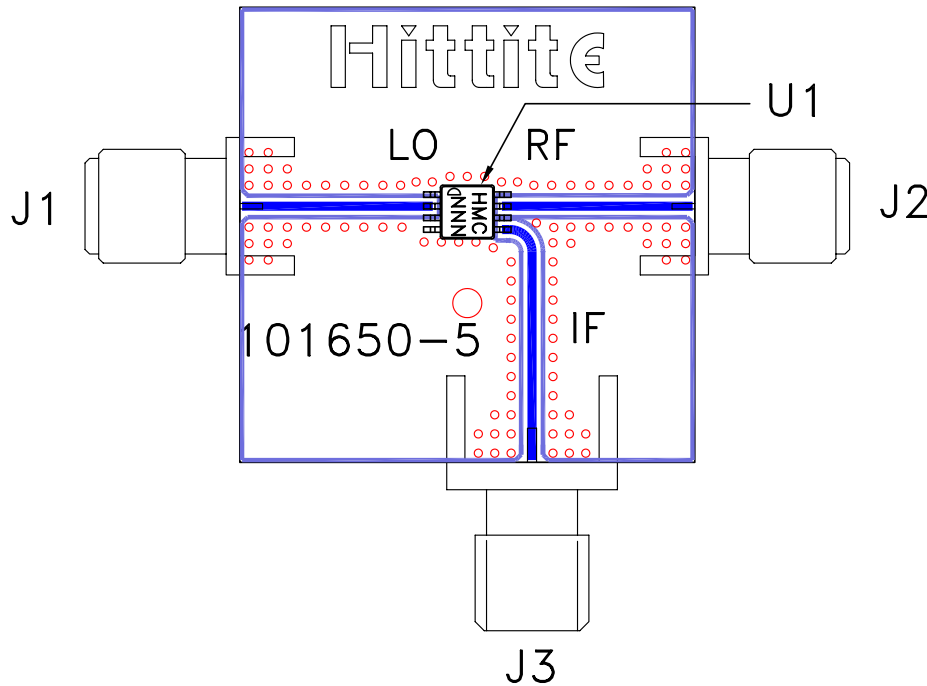
Application Support: Phone: 978-250-3343 or [apps@hittite.com](mailto:apps@hittite.com)



**Pin Descriptions**

Pin Number	Function	Description	Interface Schematic
1, 8	GND	Ground: Pin must connect to RF ground.	
2	LO	This pin is AC coupled and matched to 50 Ohms.	
3, 4, 6	N/C	Not Connected	
5	IF	IF Port: This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose values has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source/sink more than 4mA of current or die non-function and possible die failure will result.	
7	RF	This pin is AC coupled and matched to 50 Ohms.	

**Evaluation PCB**



**List of Materials for Evaluation PCB 103350 [1]**

Item	Description
J1 - J2	PCB Mount SMA RF Connector, SRI
J3	PCB Mount SMA Connector, Johnson
U1	HMC412MS8G / HMC412MS8GE Mixer
PCB [2]	101650 Evaluation Board

[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 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.