

# Analog Devices Welcomes Hittite Microwave Corporation

NO CONTENT ON THE ATTACHED DOCUMENT HAS CHANGED



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### Typical Applications

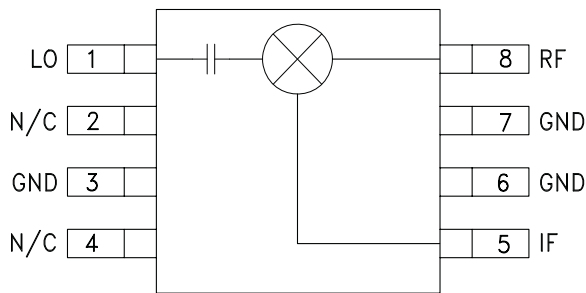
High Dynamic Range Infrastructure:

- GSM 450 & GSM 480
- CDMA 450
- Private Land Mobile Radio

### Features

- Input IP3: +32 dBm
- Conversion Loss: 9.5 dB
- Low External Part Count
- Ultra Small MSOP8 Package: 14.8 mm<sup>2</sup>
- Included in the HMC-DK003 Designer's Kit

### Functional Diagram



### General Description

The HMC387MS8 & HMC387MS8E are high dynamic range passive MMIC mixers in plastic surface mount 8 lead Mini Small Outline Packages (MSOP) covering 450 to 500 MHz. Excellent input IP3 performance of +32 dBm for down conversion and +29 dBm for up conversion is provided for both GSM/CDMA based cellular and Private Land Mobile Radio applications at an LO drive of +17 dBm. The mixer also has excellent performance with as little as +13 dBm LO drive yielding a +30 dBm input IP3. With a 1 dB compression of +22 dBm, the RF port will accept a wide range of input signal levels. Conversion loss is 9.5 dB typical. The DC to 150 MHz IF frequency response will satisfy many cellular transmit or receive frequency plans. The HMC387MS8(E) input IP3 performance coupled with its high P1dB rivals traditional active FET mixers while offering a much smaller 14.8mm<sup>2</sup> standard IC footprint and no DC bias.

### Electrical Specifications, $T_A = +25^\circ\text{C}$ , LO = +17 dBm, IF = 70 MHz <sup>[1]</sup>

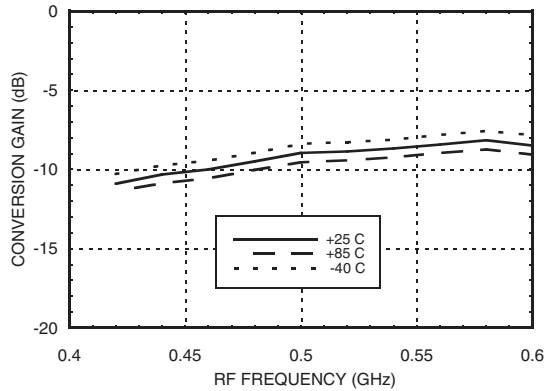
Parameter	Min.	Typ.	Max.	Units
Frequency Range, RF	450 - 500			MHz
Frequency Range, LO <sup>[2]</sup>	300 - 500			MHz
Frequency Range, IF	DC - 150			MHz
Conversion Loss		9.5	11	dB
Noise Figure (SSB)		9.5	11	dB
LO to RF Isolation	17	20		dB
LO to IF Isolation	20	23		dB
IP3 (Input)	29	32		dBm
1 dB Gain Compression (Input)	19	22		dBm
LO Input Drive Level (Typical)	+13 to +19			dBm

[1] Unless otherwise noted, all measurements performed as a downconverter with low side LO & IF = 70 MHz

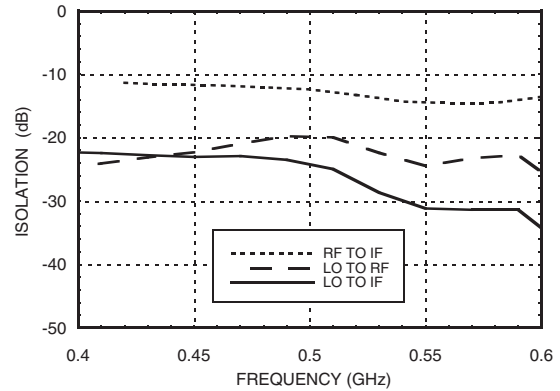
[2] LO Frequency optimized. See application circuit herein.



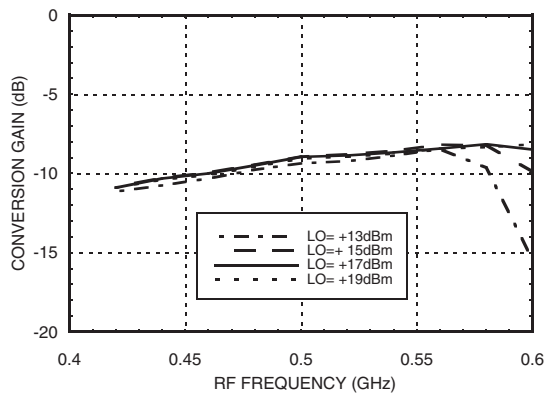
**Conversion Gain vs.  
Temperature @ LO = +17 dBm**



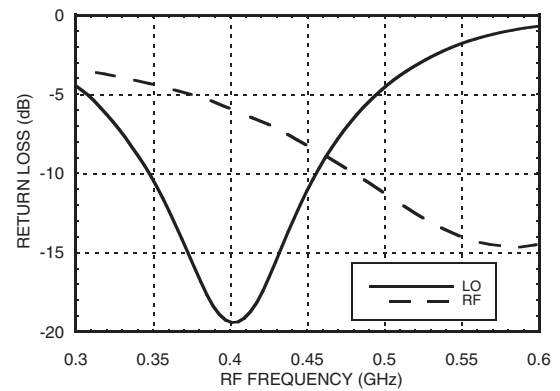
**Isolation @ LO = +17 dBm**



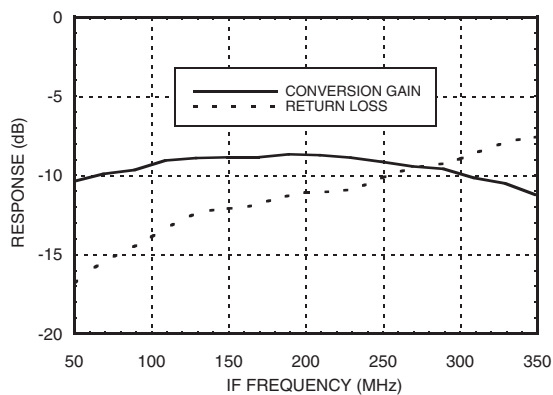
**Conversion Gain vs. LO Drive**



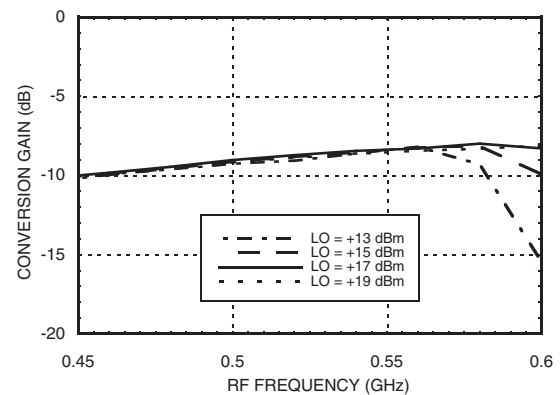
**Return Loss @ LO = +17 dBm**



**IF Bandwidth @ LO = +17 dBm**

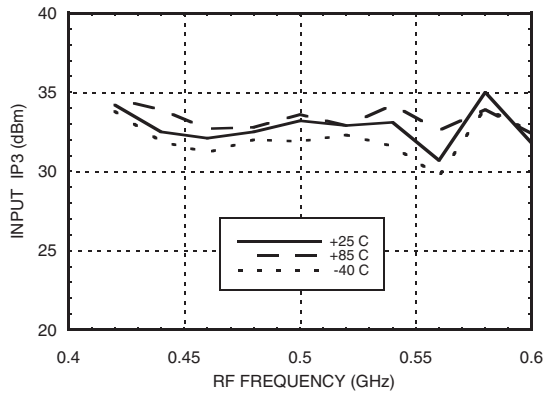


**Upconverter Conversion Gain vs.  
LO Drive**

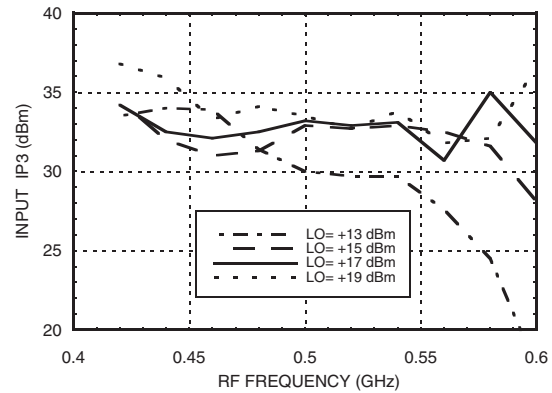




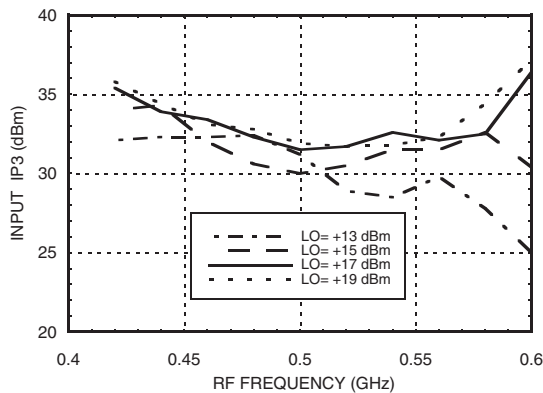
**Input IP3 vs. Temperature**  
IF = 70 MHz, LO = +17 dBm



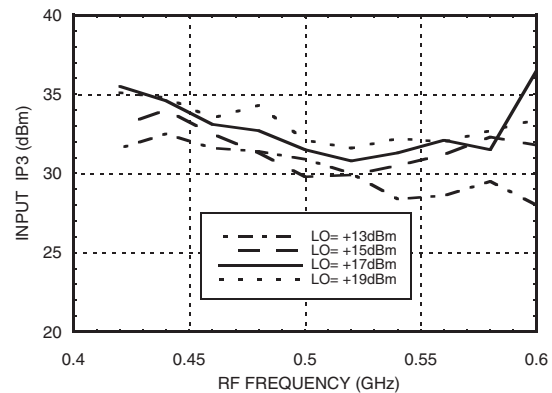
**Input IP3 vs. LO Drive**  
IF = 70 MHz



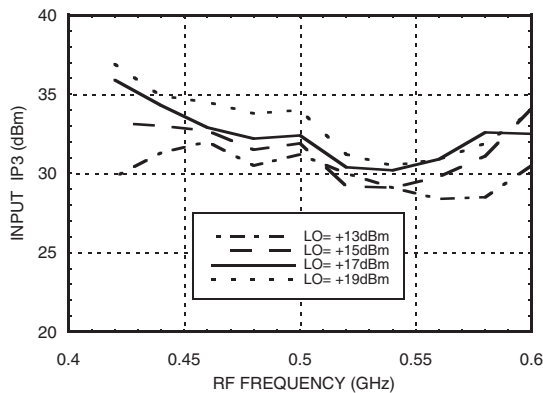
**Input IP3 vs. LO Drive**  
IF = 97 MHz



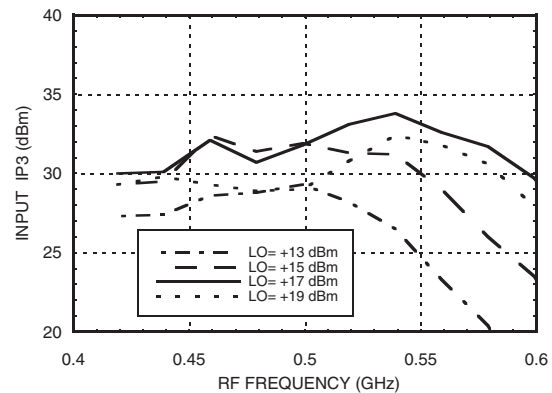
**Input IP3 vs. LO Drive**  
IF = 117 MHz



**Input IP3 vs. LO Drive**  
IF = 137 MHz

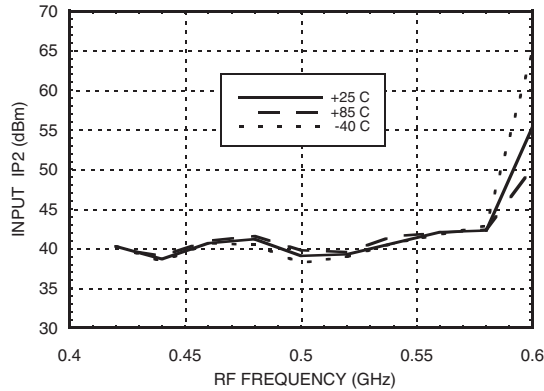


**Upconverter Input IP3 vs. LO Drive**  
IF = 70 MHz

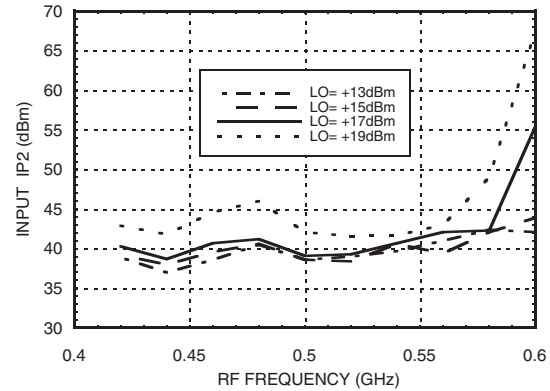




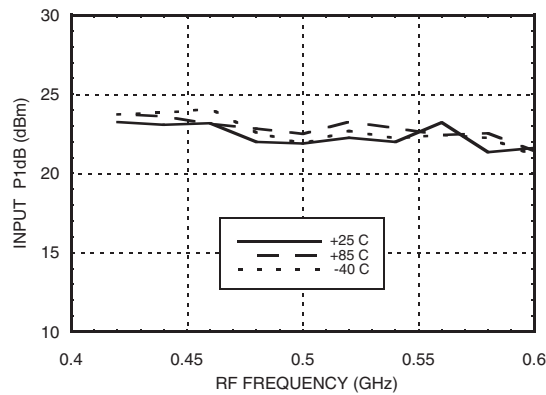
### Input IP2 vs. Temperature @ LO = +17 dBm



### Input IP2 vs. LO Drive



### Input P1dB vs. Temperature IF = 70 MHz



### MxN Spurious Outputs

mRF	nLO				
	0	1	2	3	4
0	xx	-5	13	13	6
1	1.5	0	27	25	42
2	54	65	47	53	61
3	83	77	85	74	70
4	85	85	85	85	85

RF Freq = 0.45 GHz @ 0 dBm  
LO Freq = 0.38 GHz @ +17 dBm  
All values in dBc relative to the IF output power.

### Harmonics of LO

LO Freq (GHz)	nLO Spur @ RF Port			
	1	2	3	4
0.35	27	37	38	39
0.37	26	35	43	39
0.39	25	34	44	41
0.41	24	33	41	43
0.43	23	32	38	44
0.45	22	31	37	45

LO = +17 dBm  
All values are in dBc below input LO level @ RF port.



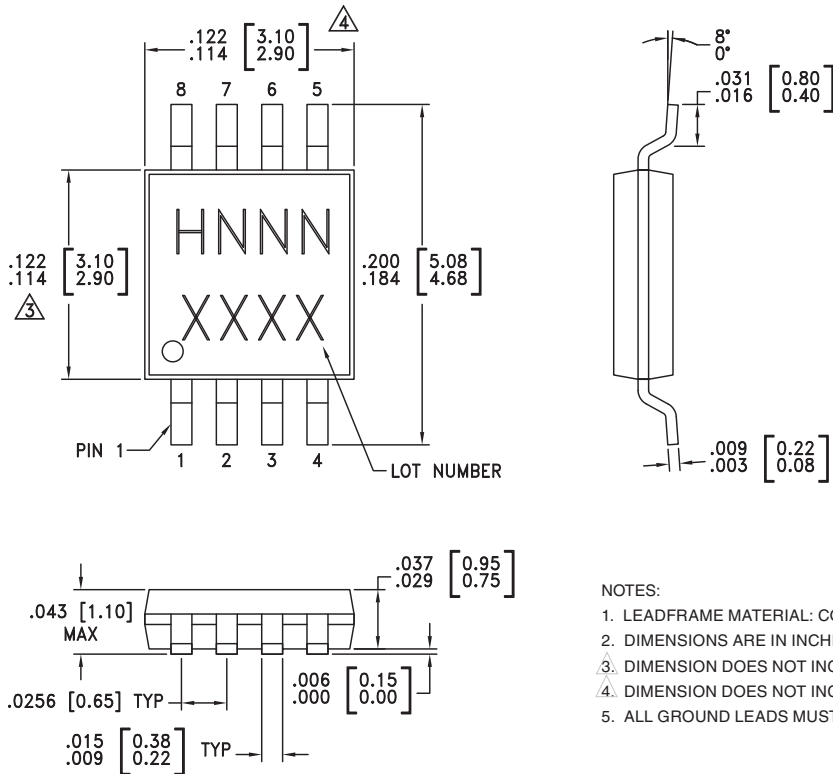
**Absolute Maximum Ratings**

RF/IF Input	+25 dBm
LO Drive	+27 dBm
Channel Temperature (Tc)	150 °C
Thermal Resistance	175 °C/W
Storage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C
IF DC Current	±40 mA
ESD Sensitivity (HBM)	Class 1A



**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.

**Package Information**

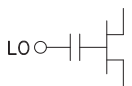

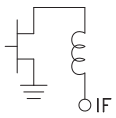
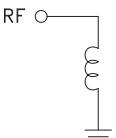
Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking <sup>[3]</sup>
HMC387MS8	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL1 <sup>[1]</sup>	H387 XXXX
HMC387MS8E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 <sup>[2]</sup>	H387 XXXX

[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)



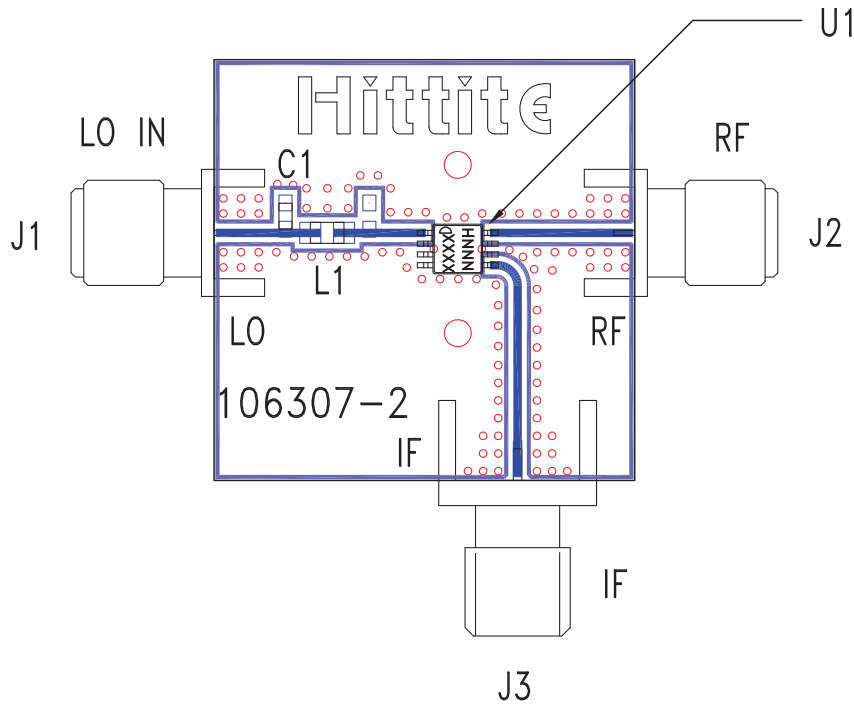
**Pin Descriptions**

Pin Number	Function	Description	Interface Schematic
1	LO	This pin is AC coupled & matched to 50 Ohms when an external series inductor (L1) and shunt capacitor (C1) is connected to the LO. Choose values of L1 and C1 to optimize LO frequency response. See Application Circuit herein.	
2, 4	N/C	Not connected.	
3, 6, 7	GND	This pin must be connected to RF ground.	
5	IF	This pin is DC coupled. For applications not requiring operation to DC this port should be DC blocked externally using a series capacitor. Choose value of C1 to pass IF frequency desired. For operation to DC, this pin must not sink/source more than 40 mA of current or failure may result.	
8	RF	This pin is DC coupled & matched to 50 Ohms from 450 - 500 MHz	





**Evaluation PCB**



**List of Materials for Evaluation PCB 107334 [1]**

Item	Description
J1 - J3	PCB Mount SMA RF Connector
C1	4 pF Chip Capacitor, 0603 Pkg
L1	47 nH Chip Inductor, 0805 Pkg
U1	HMC387MS8 / HMC387MS8E Mixer
PCB [2]	106307 Eval Board

[1] Reference this number when ordering complete evaluation PCB

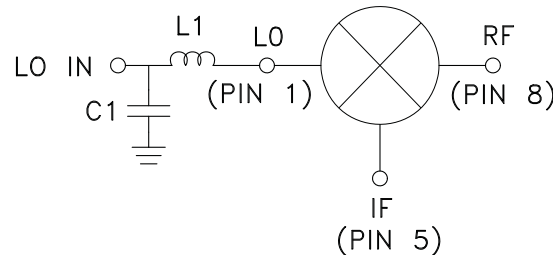
[2] Circuit Board Material: Rogers 4350

[3] Unless otherwise noted, all measurements performed as a downconverter with low side LO & IF = 200 MHz

[4] LO Frequency optimized. See application circuit herein.

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 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



### Selection of L1 & C1 for Optimal LO Frequency $\pm 10\%$

Choose value of L1 & C1 to optimize LO Frequency response. For best results use an 0805 size RF inductor or smaller.

LO Frequency (MHz)	L1 (nH)	C1 (pF)
400	47	4

Note: Position L1 and C1 as close to Pin 1 as possible.