

## GaAs MMIC DOUBLE-BALANCED MIXER, 25 - 40 GHz

### Typical Applications

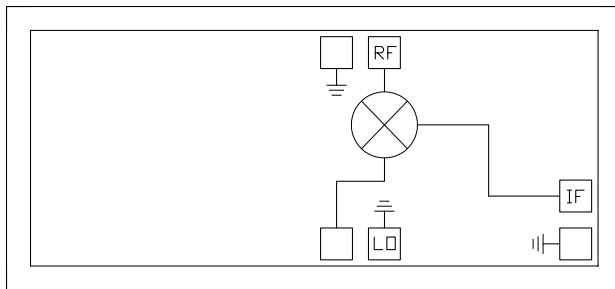
The HMC294 is ideal for:

- Microwave Pt to Pt Radios
- LMDS
- SATCOM

### Features

- Input IP3: +20 dBm
- LO / RF Isolation: 27 dB
- Passive: No DC Bias Required
- Small Size: 0.88 mm x 1.93 mm

### Functional Diagram



### General Description

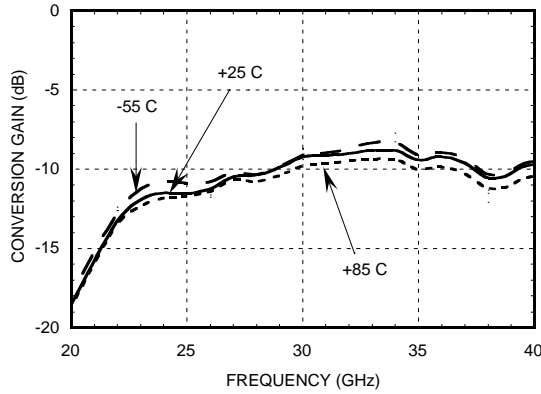
The HMC294 chip is a miniature passive GaAs MMIC double-balanced mixer which can be used as an upconverter or downconverter from 25 - 40 GHz in a small chip area of 1.70 mm<sup>2</sup>. Excellent isolations are provided by on-chip baluns, which require no external components and no DC bias. All data is measured with the chip in a 50 ohm test fixture connected via 0.076 mm (3 mil) gold ribbon of minimal length <0.31 mm (<12 mils).

### Electrical Specifications, $T_A = +25^\circ\text{C}$ , LO Drive = +14 dBm

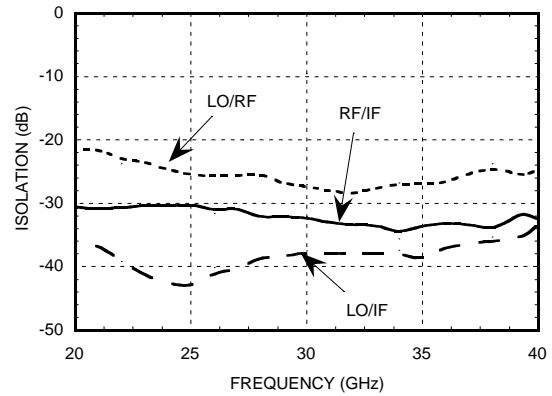
Parameter	Min.	Typ.	Max.	Units
Frequency Range, RF & LO	25 - 40			GHz
Frequency Range, IF	DC - 2			GHz
Conversion Loss		10	13	dB
Noise Figure (SSB)		10	13	dB
LO to RF Isolation	22	27		dB
LO to IF Isolation	31	38		dB
RF to IF Isolation	27	33		dB
IP3 (Input)	15	20		dBm
IP2 (Input)	24	35		dBm
1 dB Gain Compression (Input)	9	12		dBm

**GaAs MMIC DOUBLE-BALANCED  
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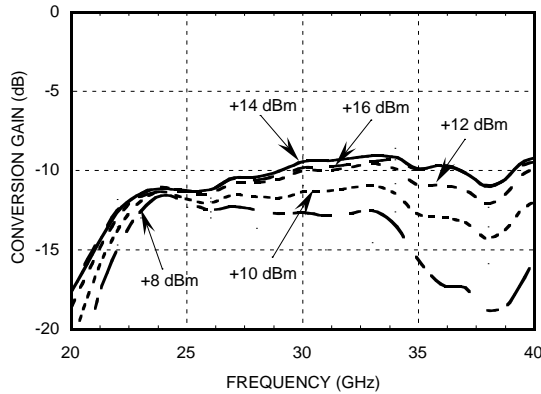
**Conversion Gain vs.  
Temperature @ LO = +14 dBm**



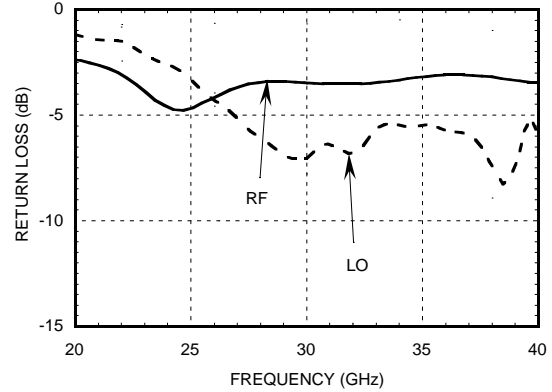
**Isolation @ LO = +14 dBm**



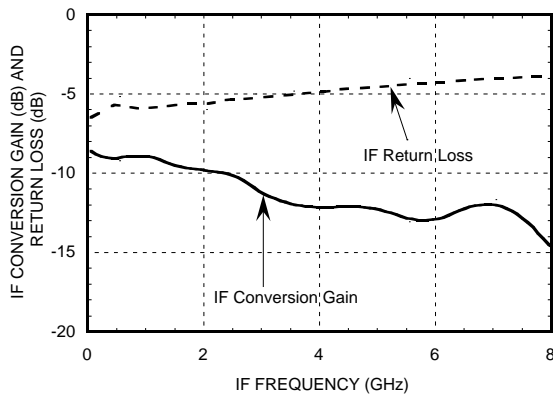
**Conversion Gain vs. LO Drive**



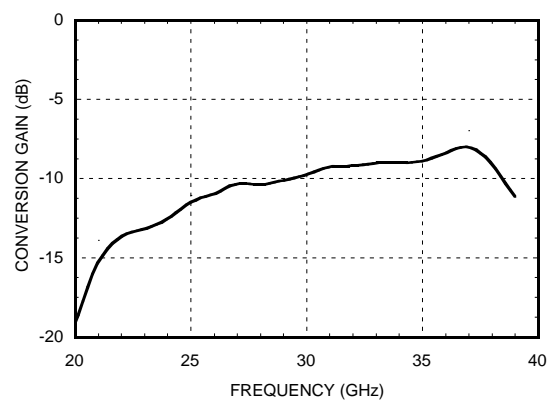
**Return Loss @ LO = +14 dBm**



**IF Bandwidth @ LO = +14 dBm**

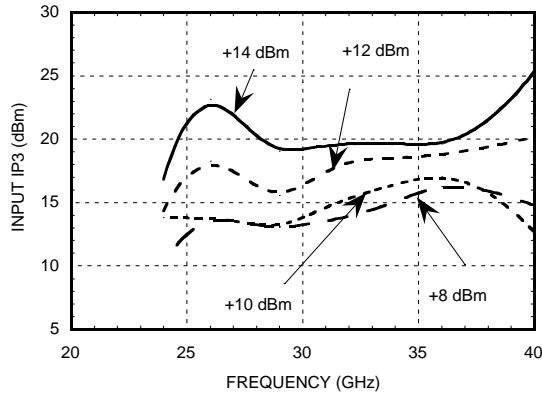


**Upconverter Performance  
Conversion Gain @ LO = +14 dBm**

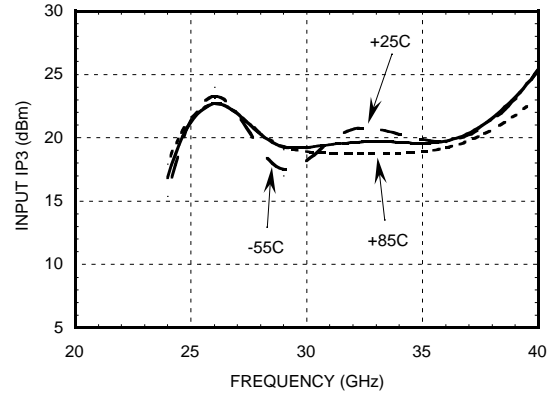


## GaAs MMIC DOUBLE-BALANCED MIXER, 25 - 40 GHz

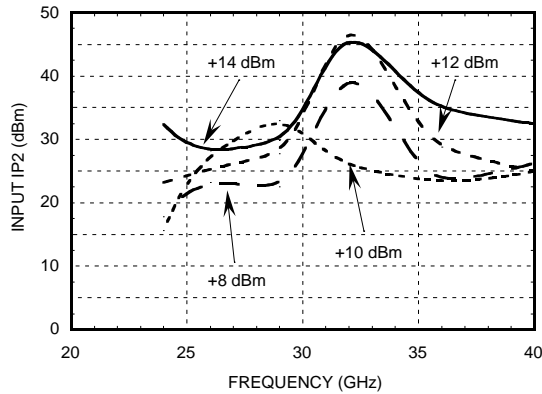
**Input IP3 vs. LO Drive**



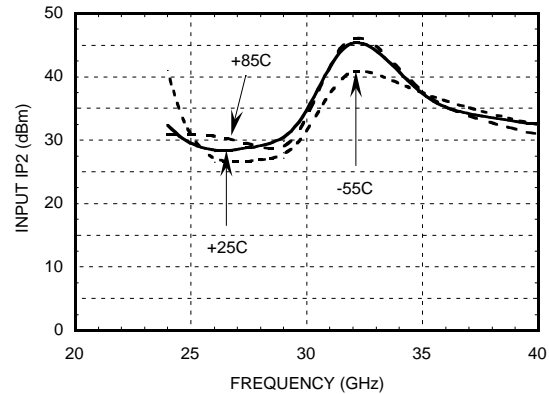
**Input IP3 vs. Temperature @ LO = +14 dBm**



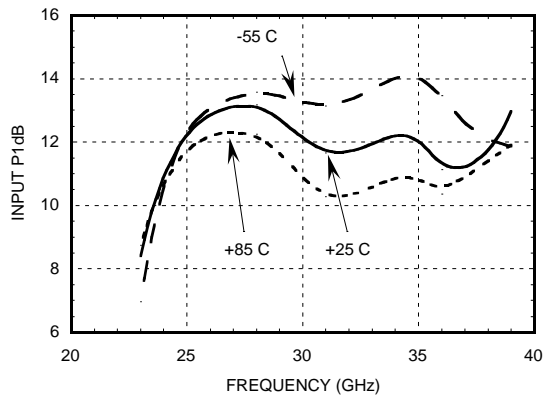
**Input IP2 vs. LO Drive**



**Input IP2 vs. Temperature @ LO = +14 dBm**



**Input P1dB vs. Temperature @ LO = +14 dBm**



**MxN Spurious Outputs**

mRF	nLO				
	0	1	2	3	4
0	xx	3.9			
1	25	0	47		
2		91	59	86	
3			>110	68	105
4				>110	106

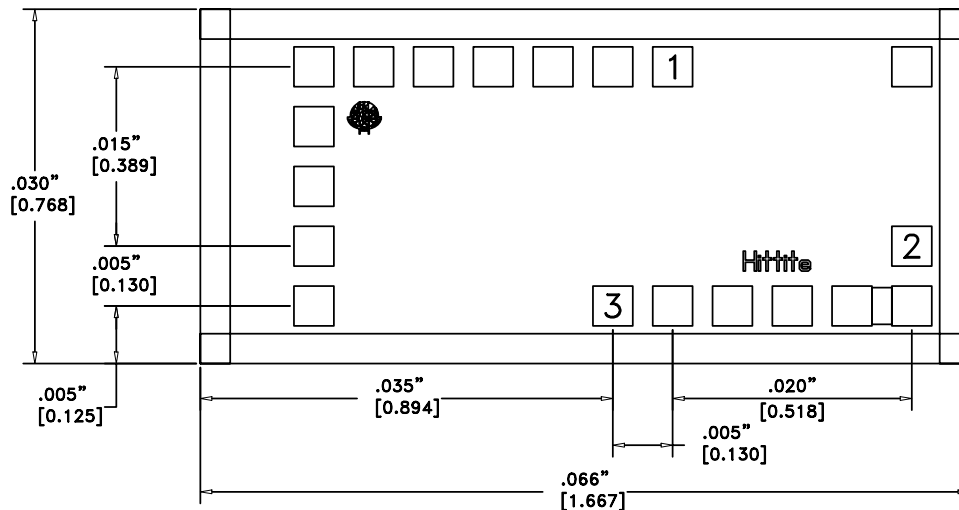
RF = 35 GHz @ -10 dBm  
LO = 34 GHz @ +14 dBm  
All values in dBc below the IF power level.

## GaAs MMIC DOUBLE-BALANCED MIXER, 25 - 40 GHz

### Absolute Maximum Ratings

RF / IF Input	+13 dBm
LO Drive	+27 dBm
Storage Temperature	-65 to +150 °C
Operating Temperature	-55 to +125 °C

### Outline Drawing

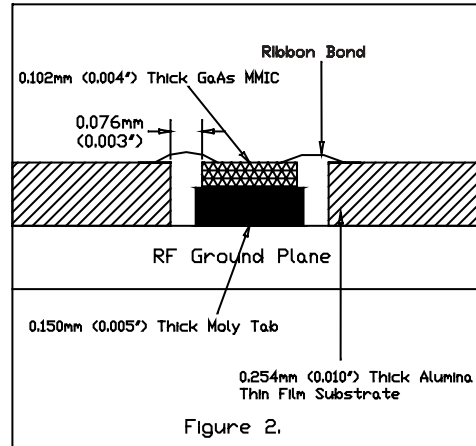
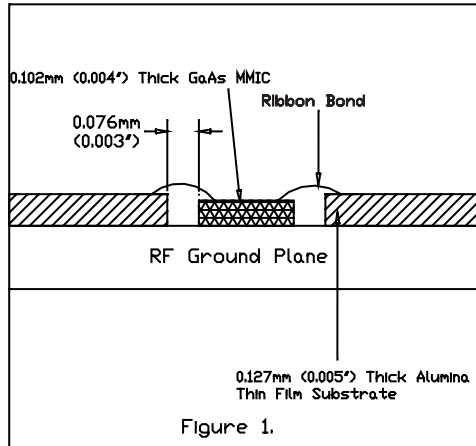


NOTES:

1. ALL DIMENSIONS ARE IN INCHES [MM].
2. DIE THICKNESS IS .004".
3. TYPICAL BOND PAD IS .004" SQUARE.
4. BACKSIDE METALLIZATION: GOLD.
5. BOND PAD METALLIZATION: GOLD.
6. BACKSIDE METAL IS GROUND.
7. CONNECTION NOT REQUIRED FOR UNLABELED BOND PADS.

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**MIC Assembly Techniques**



**Mounting & Bonding Techniques for Millimeterwave GaAs MMICs**

The die should be attached directly to the ground plane eutectically or with conductive epoxy (see HMC general Handling, Mounting, Bonding Note).

50 Ohm Microstrip transmission lines on 0.127mm (5 mil) thick alumina thin film substrates are recommended for bringing RF to and from the chip (Figure 1). If 0.254mm (10 mil) thick alumina thin film substrates must be used, the die should be raised 0.150mm (6 mils) so that the surface of the die is coplanar with the surface of the substrate. One way to accomplish this is to attach the 0.102mm (4 mil) thick die to a 0.150mm (6 mil) thick molybdenum heat spreader (moly-tab) which is then attached to the ground plane (Figure 2).

Microstrip substrates should be brought as close to the die as possible in order to minimize bond wire length. Typical die-to-substrate spacing is 0.076mm (3 mils). Gold ribbon of 0.076 mm x 0.013 mm (3 mil x 0.5 mil) and minimal length <0.31 mm (<12 mils) is recommended to minimize inductance on the RF ports.

**GaAs MMIC DOUBLE-BALANCED  
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*Follow these precautions to avoid permanent damage.*

**Cleanliness:** Handle the chips in a clean environment. DO NOT attempt to clean the chip using liquid cleaning systems.

**Static Sensitivity:** Follow ESD precautions to protect against  $> \pm 250V$  ESD strikes.

**Transients:** Suppress instrument and bias supply transients while bias is applied. Use shielded signal and bias cables to minimize inductive pick-up.

**General Handling:** Handle the chip along the edges with a vacuum collet or with a sharp pair of bent tweezers. The surface of the chip has fragile air bridges and should not be touched with vacuum collet, tweezers, or fingers.

**Mounting**

*The chip is back-metallized and can be die mounted with AuSn eutectic preforms or with electrically conductive epoxy. The mounting surface should be clean and flat.*

**Eutectic Die Attach:** A 80/20 gold tin preform is recommended with a work surface temperature of 255 °C and a tool temperature of 265 °C. When hot 90/10 nitrogen/hydrogen gas is applied, tool tip temperature should be 290 °C. DO NOT expose the chip to a temperature greater than 320 °C for more than 20 seconds. No more than 3 seconds of scrubbing should be required for attachment.

**Epoxy Die Attach:** Apply a minimum amount of epoxy to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip once it is placed into position. Cure epoxy per the manufacturer's schedule.

**Wire Bonding**

Ribbon bond with 0.076 mm x 0.013 mm (3 mil x 0.5 mil) size is recommended. Thermosonic wirebonding with a nominal stage temperature of 150 °C and a ball bonding force of 40 to 50 grams or wedge bonding force of 18 to 22 grams is recommended. Use the minimum level of ultrasonic energy to achieve reliable wirebonds.

Wirebonds should be started on the chip and terminated on the package or substrate. All bonds should be as short as possible <0.31mm (12 mils).