# GaAs MMIC I/Q MIXER 5.9 - 12 GHz

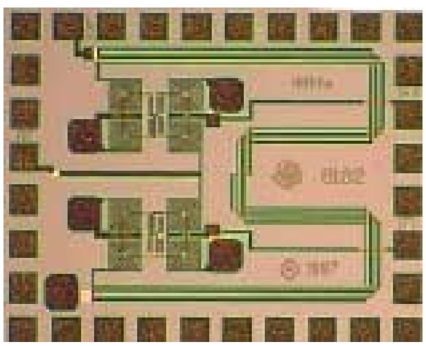
FEBRUARY 2001

## Features

HIGH IMAGE REJECTION: > 30dB

INPUT IP3: +18 dBm

SMALL SIZE: 1.3mm x 1.6mm



## General Description

The HMC256 chip is a compact, 2.08 mm$^2$, I/Q Mixer MMIC which can be used as a Image Reject Mixer (IRM), SSB upconverter or downconverter. The chip utilizes two standard Hittite double-balanced mixer cells and a Lange Coupler realized in GaAs MESFET technology. This IRM MMIC is designed to be used in microwave point-to- point radios, VSAT, and other SATCOM applications. All data is with the chip in a 50 ohm test fixture connected via 0.025 mm (1 mil) diameter wire bonds of minimal length <0.51 mm (<20 mils). A low frequency quadrature hybrid was used to interface the MMIC IF ports to a 120 MHz IF USB output. This provides an example of the I/Q Mixer in an IRM application. The IF may be used from 1 to 1500 MHz. This I/Q Mixer is a more reliable, much smaller replacement to hybrid drop-in style I/Q Mixer assemblies.



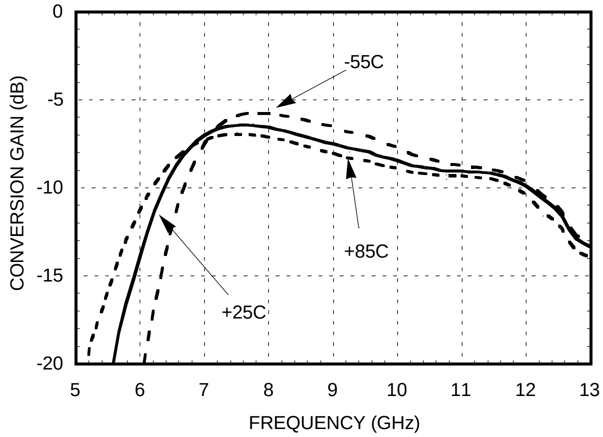
## Guaranteed Performance, *As an IRM (see pg. 4-34), -55 to + 85 deg C*

| Parameter | IF = 70 ~ 200 MHz LO = +18 dBm | | | IF = 70 ~ 200 MHz LO = +15 dBm | | | Units |
|---|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| Frequency Range, RF | | 5.9 - 12 | | | 7.1 - 11.7 | | GHz |
| Frequency Range LO | | 5.7 - 12 | | | 6.9 - 11.7 | | GHz |
| Frequency Range, IF | | DC - 1.5 | | | DC - 1.5 | | GHz |
| Conversion Loss | | 8 | 10.5 | | 8 | 10.5 | dB |
| Noise Figure (SSB) | | 8 | 10.5 | | 8 | 10.5 | dB |
| Image Rejection (IR) | 24 | 32 | | 20 | 30 | | dB |
| LO to RF Isolation | 22 | 30 | | 22 | 30 | | dB |
| LO to IF Isolation | 27 | 35 | | 27 | 35 | | dB |
| RF to IF Isolation | 24 | 30 | | 24 | 30 | | dB |
| IP3 (Input) | +14 | +18 | | +13 | +17 | | dBm |
| 1 dB Compression (Input) | | +5 | | | +5 | | dBm |
| Local Oscillator Drive Level | +12 | +18 | +20 | +12 | +15 | +20 | dBm |

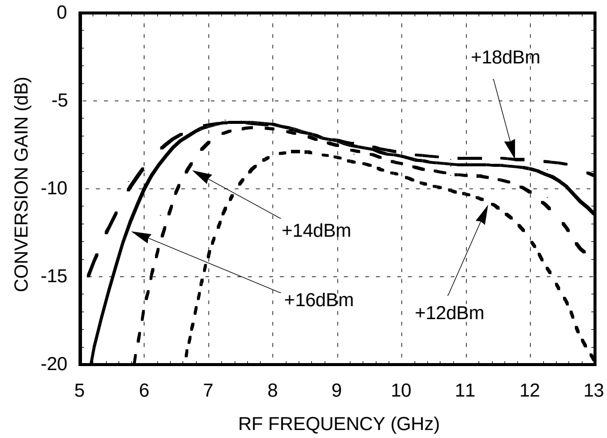
# HMC256 I/Q MIXER 5.9 - 12 GHz

FEBRUARY 2001

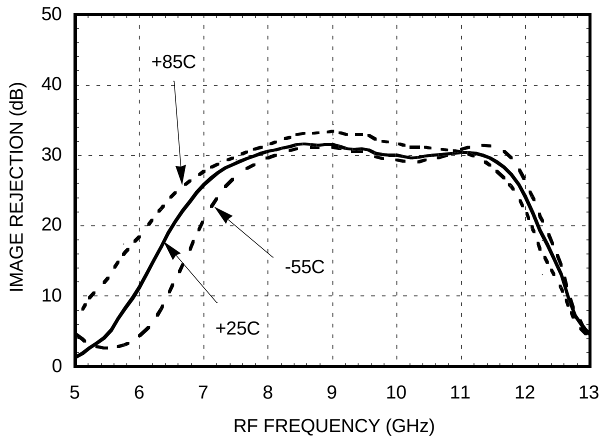
### *Conversion Gain to Desired Sideband vs. Temperature, @ LO = +15dBm, IF = 120 MHz USB.*



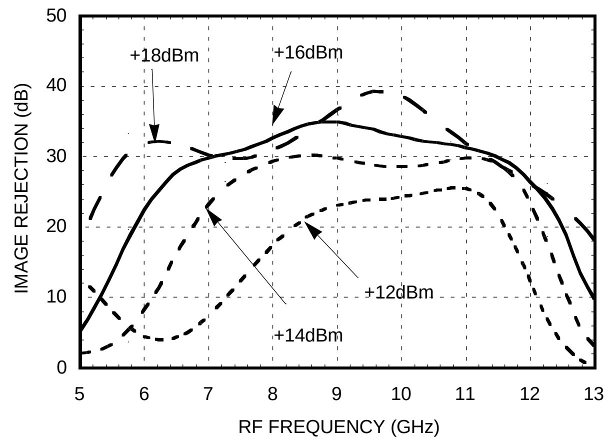

### *Conversion Gain to Desired Sideband vs. LO Drive, IF = 120 MHz USB*




### *Image Rejection vs Temperature LO = +15 dBm, IF = 120 MHz USB*




### *Image Rejection vs LO Drive, IF = 120 MHz USB*

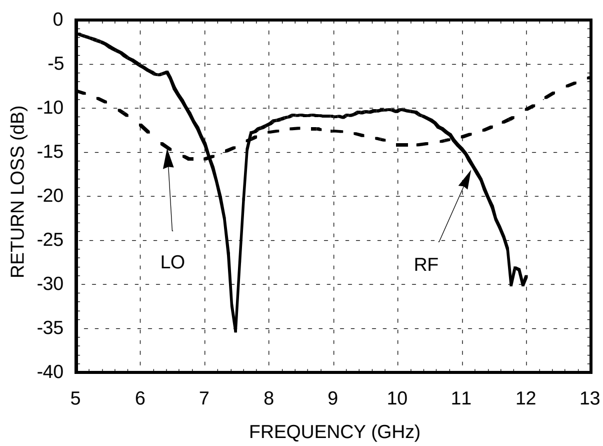


# HMC256 I/Q MIXER 5.9 - 12 GHz

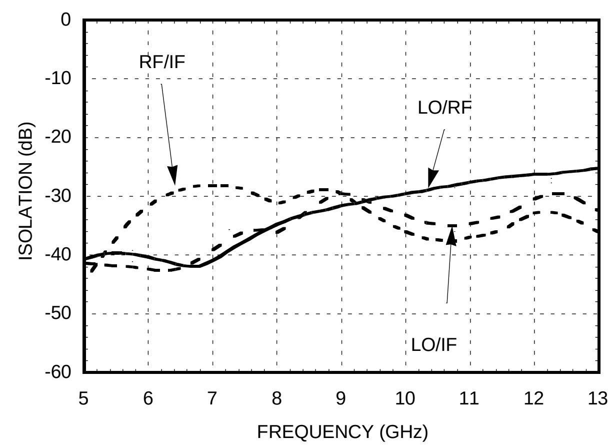
FEBRUARY 2001



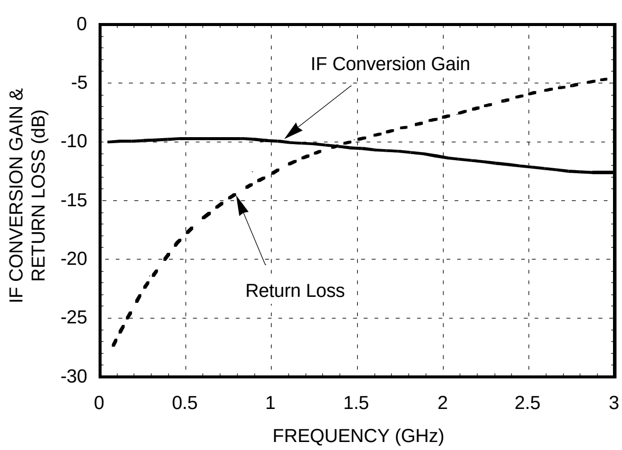
### Return Loss @ LO = +15 dBm



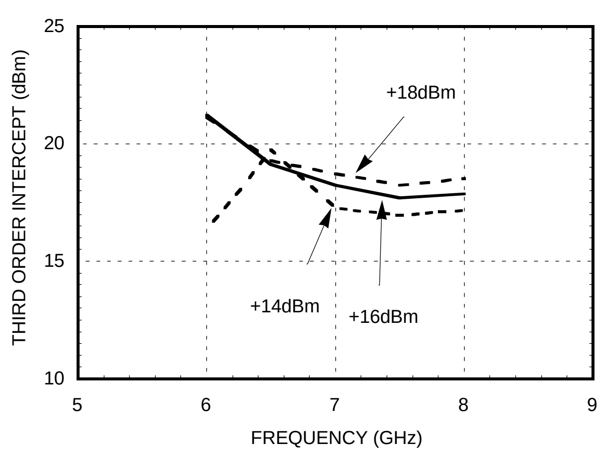

### Isolations @ LO = +15 dBm




### IF Bandwidth @ LO = +15 dBm



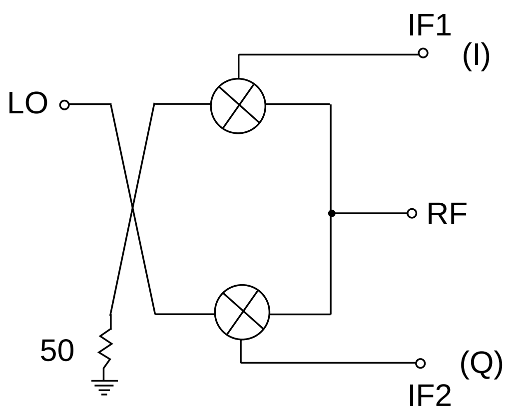

### Input IP3 vs. LO Drive, IF = 120 MHz USB



# HMC256 I/Q MIXER 5.9 - 12 GHz

FEBRUARY 2001

## Schematic

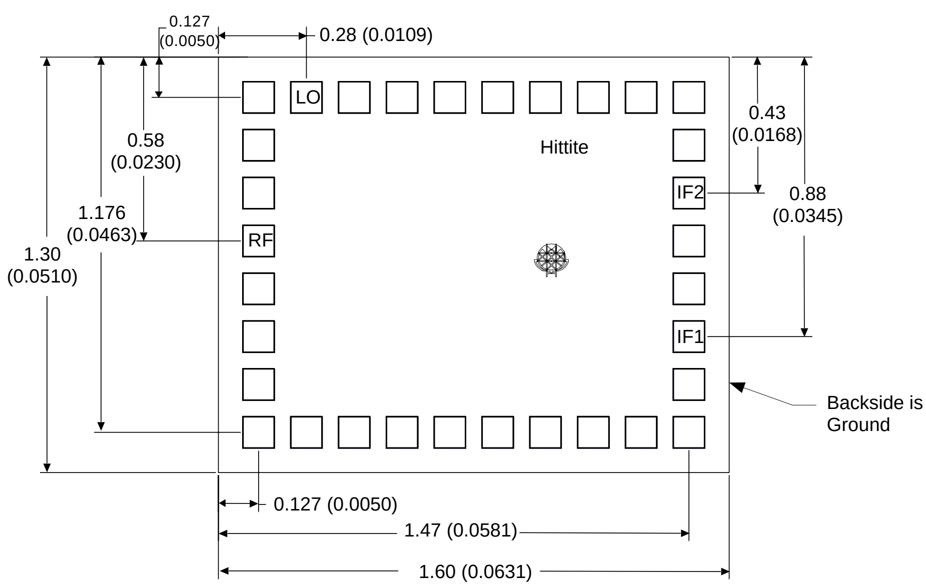



## Absolute Maximum Ratings

| | |
|---|---|
| RF / IF Input | +13 dBm |
| LO Drive | +13 dBm |
| Storage Temperature | -65 to +150 deg C |
| Operating Temperature | -55 to +85 deg C |



## Outline Drawing *( See Die Handling, Mounting, Bonding Note Page 4-98)*




ALL DIMENSION IN MILLIMETERS (INCHES)
ALL TOLERANCES ARE ±0.025 (0.001)
DIE THICKNESS IS 0.100 (0.004) BACKSIDE IS GROUND
BOND PADS ARE 0.100 (0.004) SQUARE
BOND PAD SPACING, CTR-CTR: 0.150 (0.006)
BACKSIDE METALLIZATION: GOLD
BOND PAD METALLIZATION: GOLD

## HMC256 I/Q MIXER 5.9 - 12 GHz

FEBRUARY 2001

### Image Reject Mixer Suggested Application Circuit

Below in ***Figure1*** is a photo and in ***Figure 2*** a schematic of the HMC256 image reject mixer MMIC die connected to a quadrature hybrid (120 MHz) manufactured by Merrimac Industries West Caldwell, NJ (P/N QHZ-2A-120).

Data presented for the HMC256 MMIC IRM was obtained using the circuit described here. Please note that the image rejection and isolation performance is dependent on the selection of the low frequency hybrid. The performance specification of the low frequency quadrature hybrid as well as the phase balance and VSWR of the interface circuit to the HMC256 MMIC will effect the overall IRM performance.



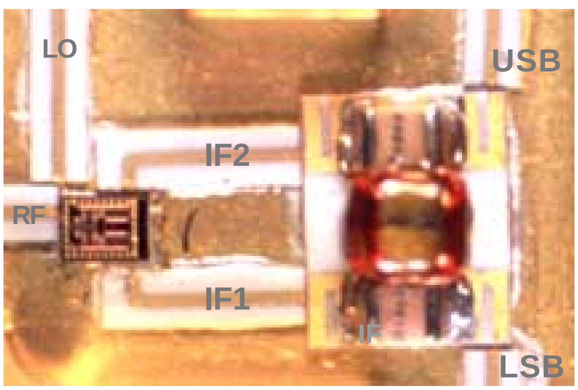



*Figure 1: Complete MIC IRM Assembly*

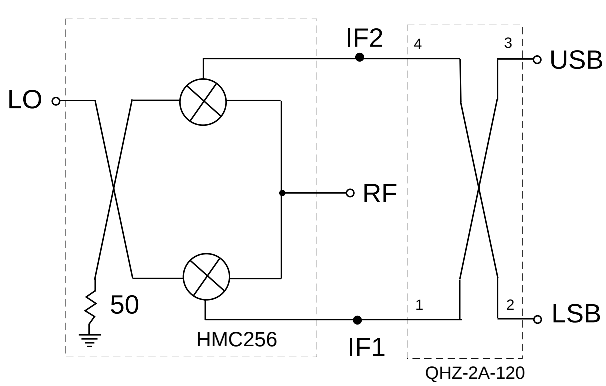



*Figure 2: Schematic of HMC256 IRM MMIC Connected to the Quadrature Hybrid*

# HMC256 I/Q MIXER 5.9 - 12 GHz

FEBRUARY 2001

## Handling Precautions

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 $\geq \pm$ 250V ESD strikes ( *see page 8 - 2* ).
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 deg. C and a tool temperature of 265 deg. C. When hot 90/10 nitrogen/hydrogen gas is applied, tool tip temperature should be 290 deg. C.
DO NOT expose the chip to a temperature greater than 320 deg. 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

Ball or wedge bond with 0.025 mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 deg. 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 <0.51 mm (20 mils).