

**INTRODUCING HITTITE GaAs MMIC MIXERS**

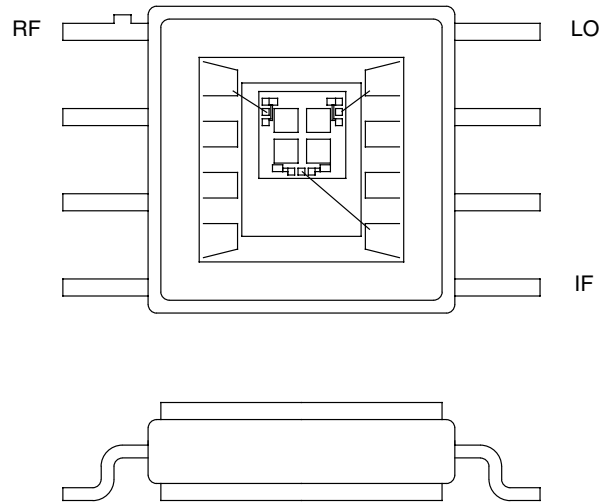
The key to achieving high levels of integration for frequency converters is the compact implementation of a low noise, high isolation double balanced mixer as an IC. Hittite's family of MMIC mixers provides a solution to this problem that is neither expensive nor difficult to use.

A family of miniature double balanced mixer chips developed with Gallium Arsenide (GaAs) MMIC technology is now available in chip or packaged form. Various models cover the S-, C-, and X-bands in octave and multi-octave bandwidths from 1.8 to 12 GHz. The mixers can operate as up or down converters and do not require DC bias.

The Hittite double balanced mixers use planar transformer baluns integrated on the IC chip that have been patterned in a novel symmetric layout which enhances the isolation properties of mixers. Typical LO to RF isolation is 40 dB and LO to IF isolation is 30 dB. The excellent balance of these double balanced mixers produces correspondingly excellent m x n spurious harmonic suppression.

Hittite mixer chips and converter ICs require no external balun circuitry, enabling them to be directly inserted into small commercial packages and MIC modules. As an example, Figure 1 shows the HMC128 MMIC mixers mounted in a commercially available surface mount package (Hittite G8).

Hittite's mixers have broad IF frequency bandwidths as large as DC to 6 GHz and low conversion loss and single sideband noise figure. All mixer modules also feature good 3rd order intermodulation and 1 dB gain compression performance. Typical IP3 at input is +21 dBm.



**Figure 1:** HMC128 MMIC mixer mounted in a commercial surface mount package (Hittite G8).

The LO drive requirements for these GaAs diode-based mixers is from 7 to 15 dBm with no damage at up to 1 Watt levels. Certain models that incorporate on-chip LO buffer amplifiers require 0 to 5 dBm LO drive. Port VSWR, frequency bandwidth, conversion gain, and harmonic distortion do vary with LO drive, but degrade most significantly below 7 dBm minimum drive level.

## MIXER APPLICATION NOTE

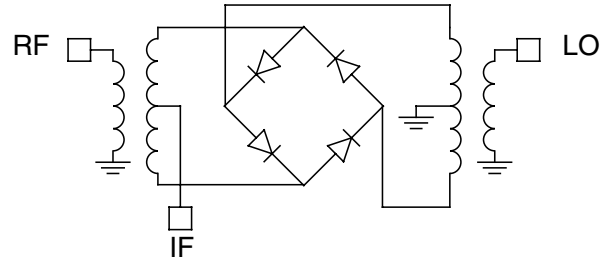
The typical mixer chip size is 1.5 x 1.6 x .10 mm (0.060" x 0.063" x .004") making them especially useful for applications where it is desirable to minimize weight and size. Via holes provide circuit ground to the chips backside, eliminating the need for ground "down" bonds. This reduces the area required for chip packaging or MMIC implementation. Back-metallization facilitates eutectic die-attach with an 80/20 gold/tin preform. Die-attach with electrically conductive epoxy is also permissible. Gold metallized bond pads, 0.10 mm (0.004") square, allow for ball or wedge bonding with 1.0 mil diameter gold wire.

RF, LO and IF ports are conveniently located, as shown in Figure 2, for easy connections to off-chip circuits and other MMIC chips for high scale integration of multiple microwave circuit functions. Figure 3 shows the HMC128 MMIC mixer and a commercial MMIC amplifier mounted in a single package.

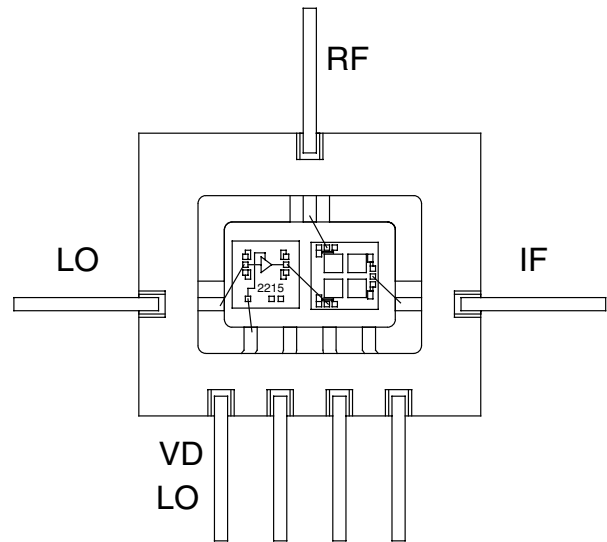
The small size of Hittite mixers and their convenient layout allow integration of mixer chips with other circuits for:

- Integrated converter with amplifiers, filters, etc.
- Single side-band modulators.
- Image rejection mixers.
- I/Q modulators and detectors.
- Phase modulators and detectors.

The high isolation and broad bandwidth attainable in Hittite mixer chips make them particularly attractive for those applications where filtering is difficult. Single-chip up or down converter products are available from Hittite that incorporate these double balanced mixers with LO buffer amplifiers, RF and IF low noise amplifiers and low pass filters.



**Figure 2:** HMC128 MMIC mixer schematic.



**Figure 3:** Hittite MMIC mixer in a commercial ceramic package (Hittite G7) with a MMIC amplifier.