

Analog Devices Welcomes Hittite Microwave Corporation

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GaAs MMIC x2 PASSIVE FREQUENCY MULTIPLIER, 20 - 40 GHz INPUT

Typical Applications

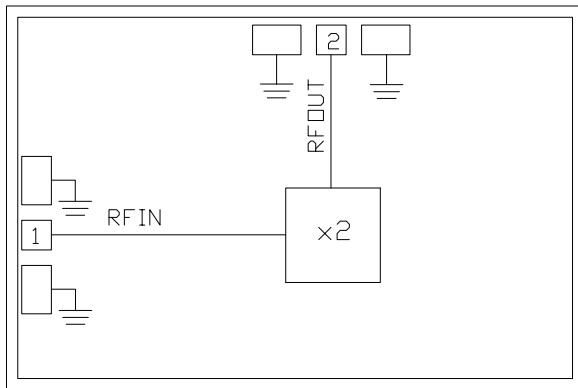
The HMC1105 is ideal for:

- Microwave Test Equipment
- Microwave/mmWave Radios
- E-Band Radios
- Military and Space

Features

- Passive: No DC Bias Required
- Conversion Loss: 12 dBm
- Fo Isolation: 41 dB
- 3Fo Isolation: 46 dB
- Die Size: 1.79 x 1.19 x 0.1 mm

Functional Diagram



General Description

The HMC1105 is a passive miniature frequency doubler in a MMIC die. Suppression of undesired fundamental and higher order harmonics is up to 41 dB typical with respect to input signal level. The doubler utilizes the same GaAs Schottky diode/balun technology found in Hittite MMIC mixers. The HMC1105 features small size, requires no DC bias, and adds no measurable additive phase noise onto the multiplied signal. The HMC1105 is compatible with conventional die attach methods which make it ideal for MCM and hybrid microcircuit applications. All data shown herein is measured with the chip in a 50 ohm environment and contacted with RF probes.

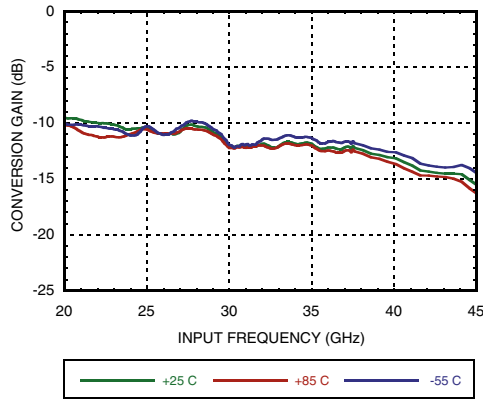
Electrical Specifications, $T_A = +25^\circ\text{C}$, Input Drive Level = +15 dBm

| Parameter | Min. | Typ. | Max | Min. | Typ. | Max. | Units |
|------------------------|---------|------|-----|---------|------|------|-------|
| Frequency Range Input | 20 - 30 | | | 30 - 40 | | | GHz |
| Frequency Range Output | 40 - 60 | | | 60 - 80 | | | GHz |
| Conversion Loss | | 11 | 15 | | 12 | 16 | dB |
| Input Return Loss | | 7 | | | 6 | | dB |
| Output Return Loss | | 13 | | | 7 | | dB |
| FO Isolation | | 41 | | | 41 | | dB |
| 3Fo Isolation | | 42 | | | 46 | | dB |

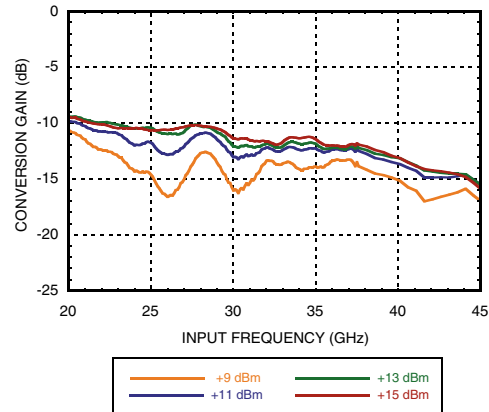


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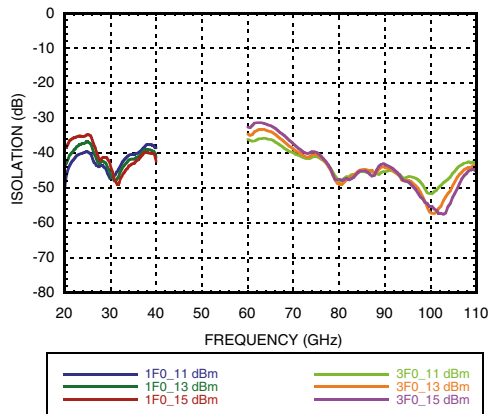
Conversion Loss vs. Temperature @ +13 dBm Drive Level



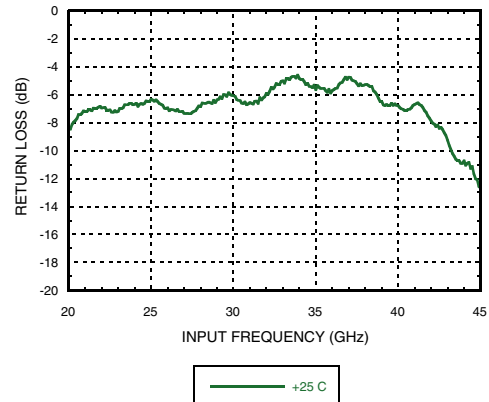
Conversion Loss vs. Drive Level



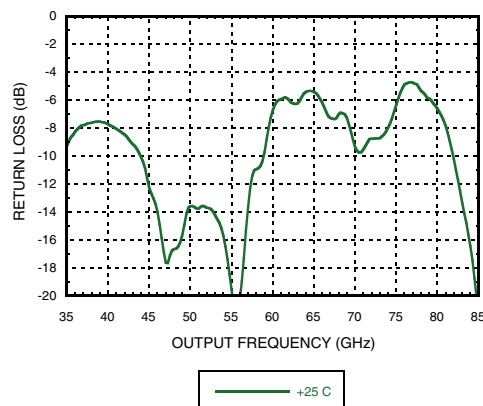
Isolation @ vs. Drive Level [1]



Input Return Loss



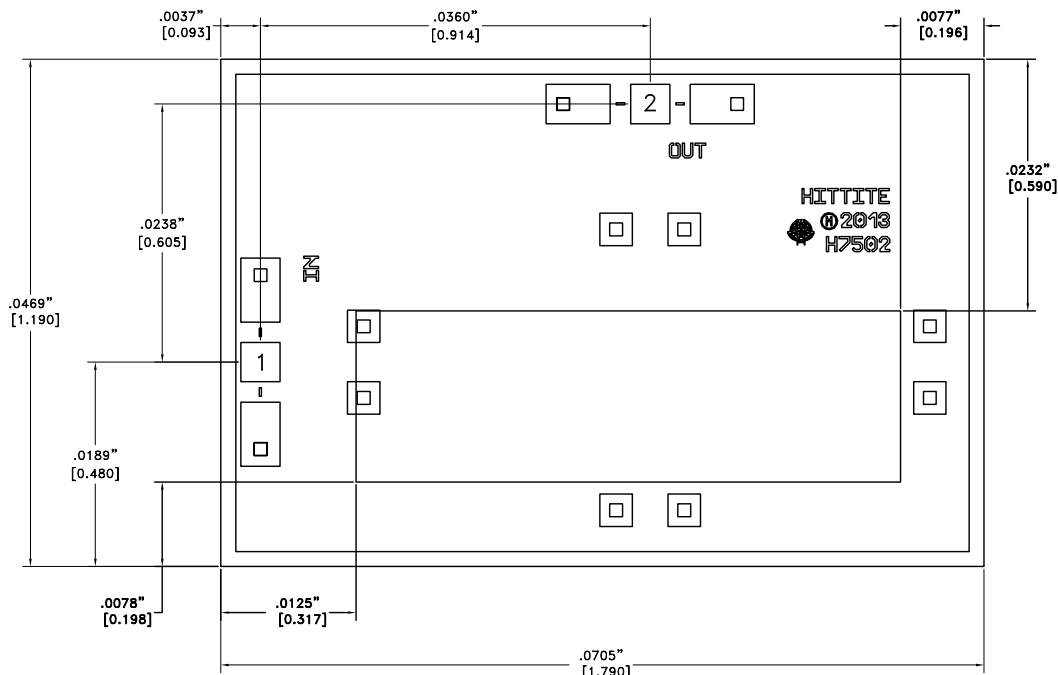
Output Return Loss



[1] Isolation measurement taken with respect to input level


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Absolute Maximum Ratings

| | |
|-------------------------------------------------------------------|------------------------|
| RF Power Input | +17 dBm |
| Channel Temperature | 175 °C |
| Thermal Resistance (R _{TH}) (junction to die bottom) | 555.6 °C/W |
| Operating Temperature | -55 to +85 °C |
| Storage Temperature | -65 to 150 °C |
| ESD Sensitivity (HBM) | Class 1A, passed 250 V |


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

Die Packaging Information ^[1]

| Standard | Alternate |
|-----------------|-----------|
| GP-2 (Gel Pack) | [2] |

[1] For more information refer to the "Packaging information" Document in the Product Support Section of our website.

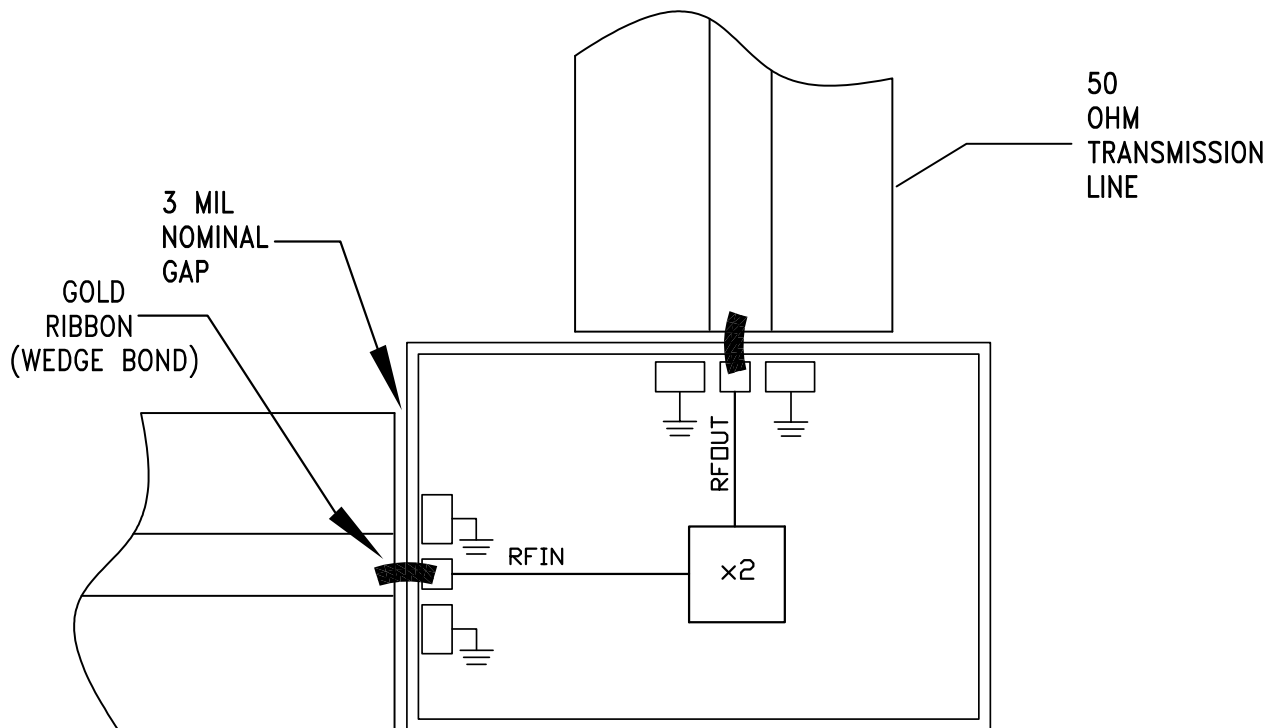
[2] For alternate packaging information contact Hittite Microwave Corporation.

NOTES:

- ALL DIMENSIONS ARE IN INCHES [MM].
- DIE THICKNESS IS 0.004"
- BOND PADS 1, 2 & 3 are 0.0059" [0.150] X 0.0039" [0.099].
- BACKSIDE METALLIZATION: GOLD.
- BOND PAD METALLIZATION: GOLD.
- BACKSIDE METAL IS GROUND.
- CONNECTION NOT REQUIRED FOR UNLABELED BOND PADS.
- OVERALL DIE SIZE ± 0.002

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Pad Descriptions

| Pad Number | Function | Description | Pad Schematic |
|------------|----------|------------------------------------------------|---------------|
| 1 | RFIN | This pad is AC coupled and matched to 50 Ohms. | RFIN ○ — — |
| 2 | RFOUT | This pad is AC coupled and matched to 50 Ohms. | — — ○ RFOUT |
| Die Bottom | GND | Die bottom must be connected to RF/DC ground | ○ GND ⏏ |

Assembly Diagram




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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). 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 located as close to the die as possible in order to minimize bond wire length. Typical die-to-substrate spacing is 0.076mm to 0.152 mm (3 to 6 mils).

Handling Precautions

Follow these precautions to avoid permanent damage.

Storage: All bare die are placed in either Waffle or Gel based ESD protective containers, and then sealed in an ESD protective bag for shipment. Once the sealed ESD protective bag has been opened, all die should be stored in a dry nitrogen environment.

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 may have fragile air bridges and should not be touched with vacuum collet, tweezers, or fingers.

Mounting

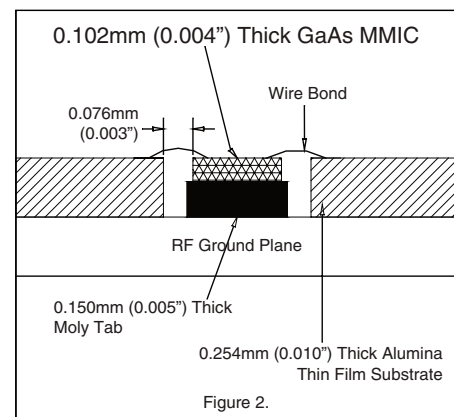
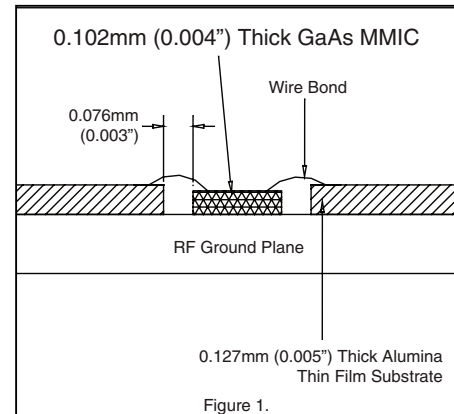
The chip is back-metallized and can be die mounted with AuSn eutectic preforms or with electrically conductive epoxy. The mounting surface should be clean and flat.

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

Ball or wedge bond with 0.025mm (1 mil) diameter pure gold wire. 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).





MICROWAVE CORPORATION v00.1013



HMC1105

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Notes:

FREQUENCY MULTIPLIER - PASSIVE - CHIP