



GaAs MMIC x2 ACTIVE FREQUENCY MULTIPLIER, 8 - 21 GHz OUTPUT

Typical Applications

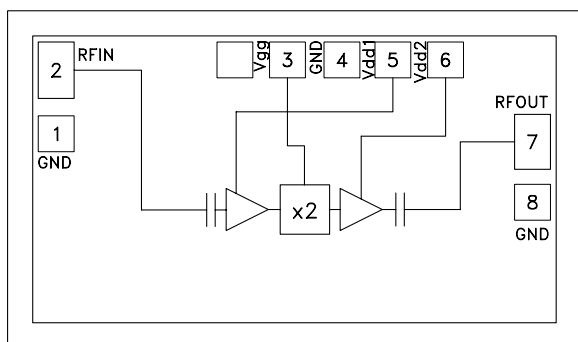
The HMC561 is suitable for:

- Clock Generation Applications:
SONET OC-192 & SDH STM-64
- Point-to-Point & VSAT Radios
- Test Instrumentation
- Military & Space

Features

- High Output Power: +17 dBm
- Low Input Power Drive: 0 to +6 dBm
- Fo Isolation: 15 dBc @ Fout= 16 GHz
- 100 KHz SSB Phase Noise: -139 dBc/Hz
- Die Size: 1.6 x 0.9 x 0.1 mm

Functional Diagram



General Description

The HMC561 is a x2 active broadband frequency multiplier chip utilizing GaAs PHEMT technology. When driven by a +5 dBm signal, the multiplier provides +17 dBm typical output power from 8 to 21 GHz and the Fo and 3Fo isolations are 15 dBc at 16 GHz. The HMC561 is ideal for use in LO multiplier chains for Pt to Pt & VSAT Radios yielding reduced parts count vs. traditional approaches. The low additive SSB Phase Noise of -139 dBc/Hz at 100 kHz offset helps maintain good system noise performance.

Electrical Specifications, $T_A = +25^\circ\text{C}$, $V_{dd1} = V_{dd2} = +5\text{V}$, 5 dBm Drive Level ^[1]

| Parameter | Min. | Typ. | Max. | Units |
|---|----------|------|------|--------|
| Frequency Range, Input | 4 - 10.5 | | | GHz |
| Frequency Range, Output | 8 - 21 | | | GHz |
| Output Power | 14 | 17 | | dBm |
| Fo Isolation (with respect to output level) | | 15 | | dBc |
| 3Fo Isolation (with respect to output level) | | 15 | | dBc |
| 4Fo Isolation (with respect to output level) | | 15 | | dBc |
| Input Return Loss | | 15 | | dB |
| Output Return Loss | | 12 | | dB |
| SSB Phase Noise (100 kHz Offset) | | -139 | | dBc/Hz |
| Supply Current (I _{dd}) (V _{dd1} = V _{dd2} = +5V, V _{gg} = -1.7V Typ.) | | 98 | 126 | mA |

[1] Adjust V_{gg} between -2.0 and -1.2V to achieve I_{dd1} + I_{dd2} = 98 mA.

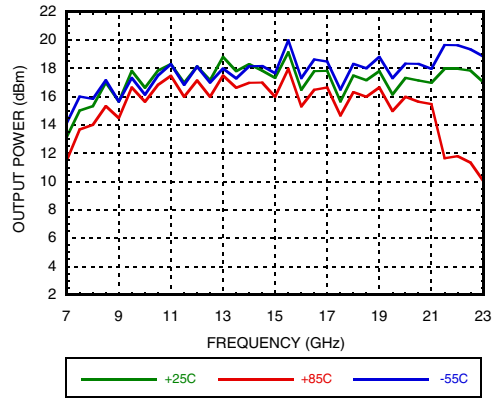
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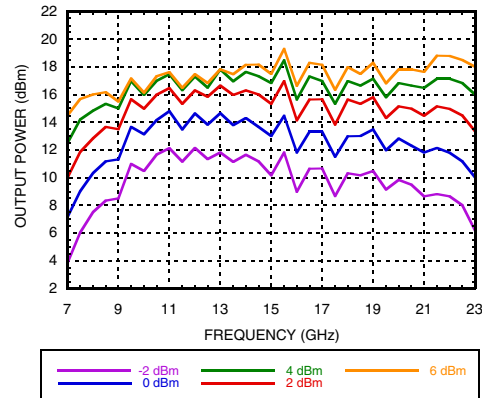


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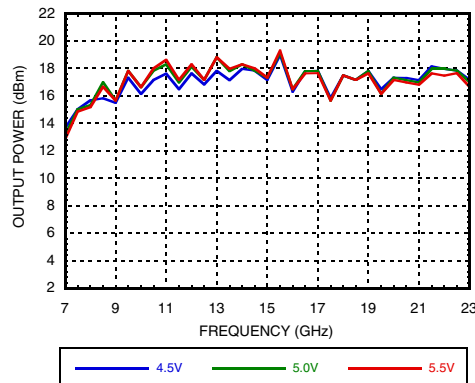
Output Power vs. Temperature @ 5 dBm Drive Level



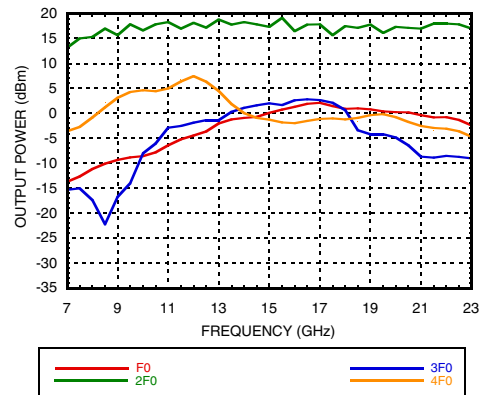
Output Power vs. Drive Level



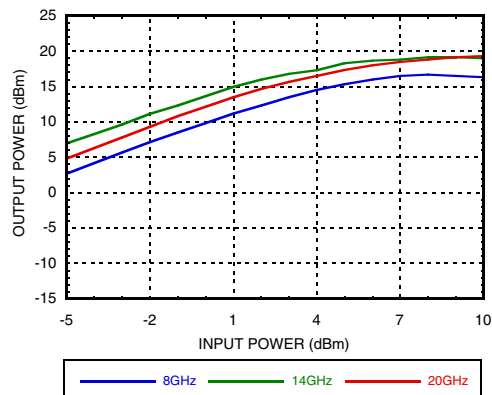
Output Power vs. Supply Voltage @ 5 dBm Drive Level



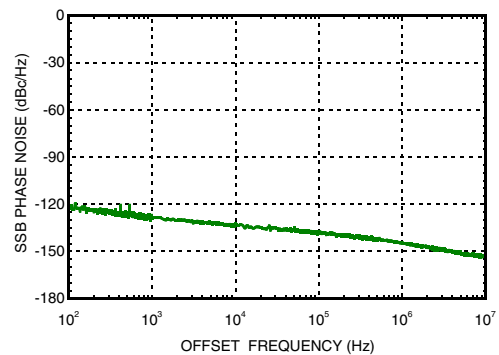
Isolation @ 5 dBm Drive Level



Output Power vs. Input Power



SSB Phase Noise Performance, Fout = 16 GHz, Input Power = +3 dBm



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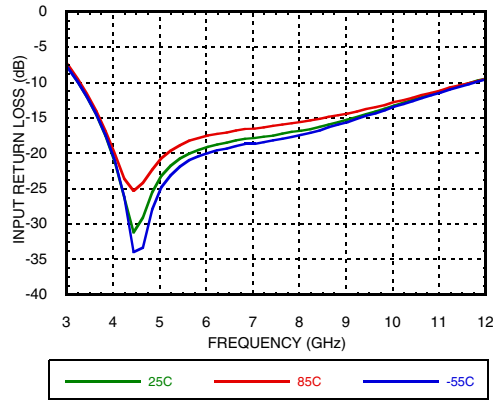
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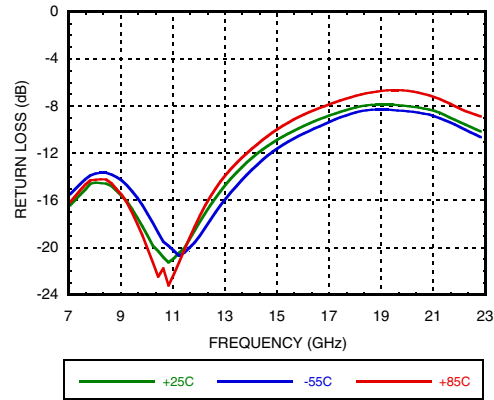
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FREQUENCY MULTIPLIER - ACTIVE - CHIP

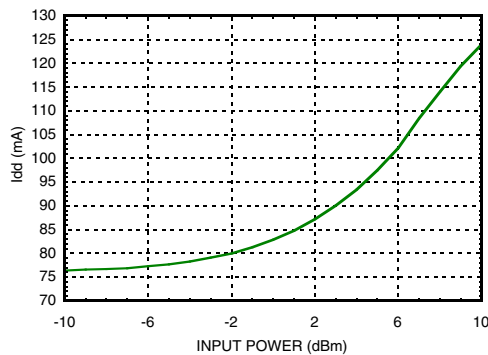
Input Return Loss vs. Temperature



Output Return Loss vs. Temperature



Supply Current vs. Input Power



Absolute Maximum Ratings

| | |
|--|----------------|
| RF Input (Vdd1= Vdd2= +5V) | +10 dBm |
| Supply Voltage (Vdd1, Vdd2) | +5.5 Vdc |
| Channel Temperature | 175 °C |
| Continuous Pdiss (T= 85 °C) (derate 10.4 mW/°C above 85 °C) | 940 mW |
| Thermal Resistance (channel to die bottom) | 95.9 °C/W |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -55 to +85 °C |

Typical Supply Current vs. Vdd1, Vdd2

| Vdd1, Vdd2 (Vdc) | I _{dd1} + I _{dd2} (mA) |
|------------------|--|
| 4.5 | 97 |
| 5.0 | 98 |
| 5.5 | 99 |



ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

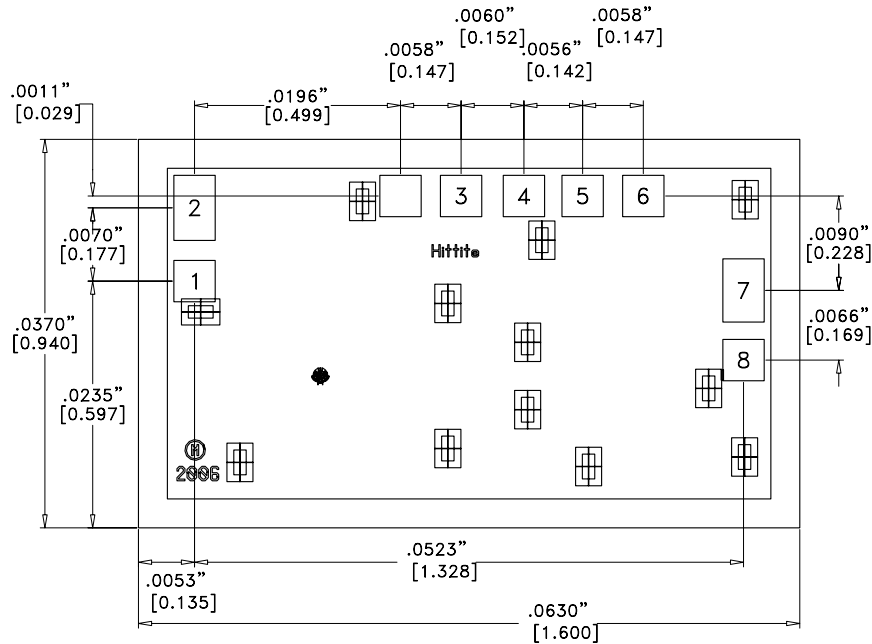
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Outline Drawing



Die Packaging Information [1]

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

- [1] Refer to the "Packaging Information" section for die packaging dimensions.
- [2] Reference this suffix only when ordering alternate die packaging.

NOTES:

1. ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).
2. DIE THICKNESS IS .004"
3. TYPICAL BOND PAD IS .004" SQUARE.
4. TYPICAL BOND SPACING IS .006" CENTER TO CENTER.
5. BOND PAD METALIZATION: GOLD
6. BACKSIDE METALIZATION: GOLD
7. BACKSIDE METAL IS GROUND.
8. NO CONNECTION REQUIRED FOR UNLABELED BOND PADS.

Pad Descriptions

| Pad Number | Function | Description | Interface Schematic |
|------------|------------|---|---------------------|
| 1, 4, 8 | GND | Die bottom must be connected to RF ground. | |
| 2 | RFIN | This pad is AC coupled and matched to 50 Ohms. | |
| 3 | Vgg | Gate control for multiplier. Adjust to achieve I _{dd} of 98 mA. Please follow "MMIC Amplifier Biasing Procedure" Application note. | |
| 5, 6 | Vdd1, Vdd2 | Supply voltage 5V ± 0.5V. | |
| 7 | RFOUT | This pad is AC coupled and matched to 50 Ohms. | |

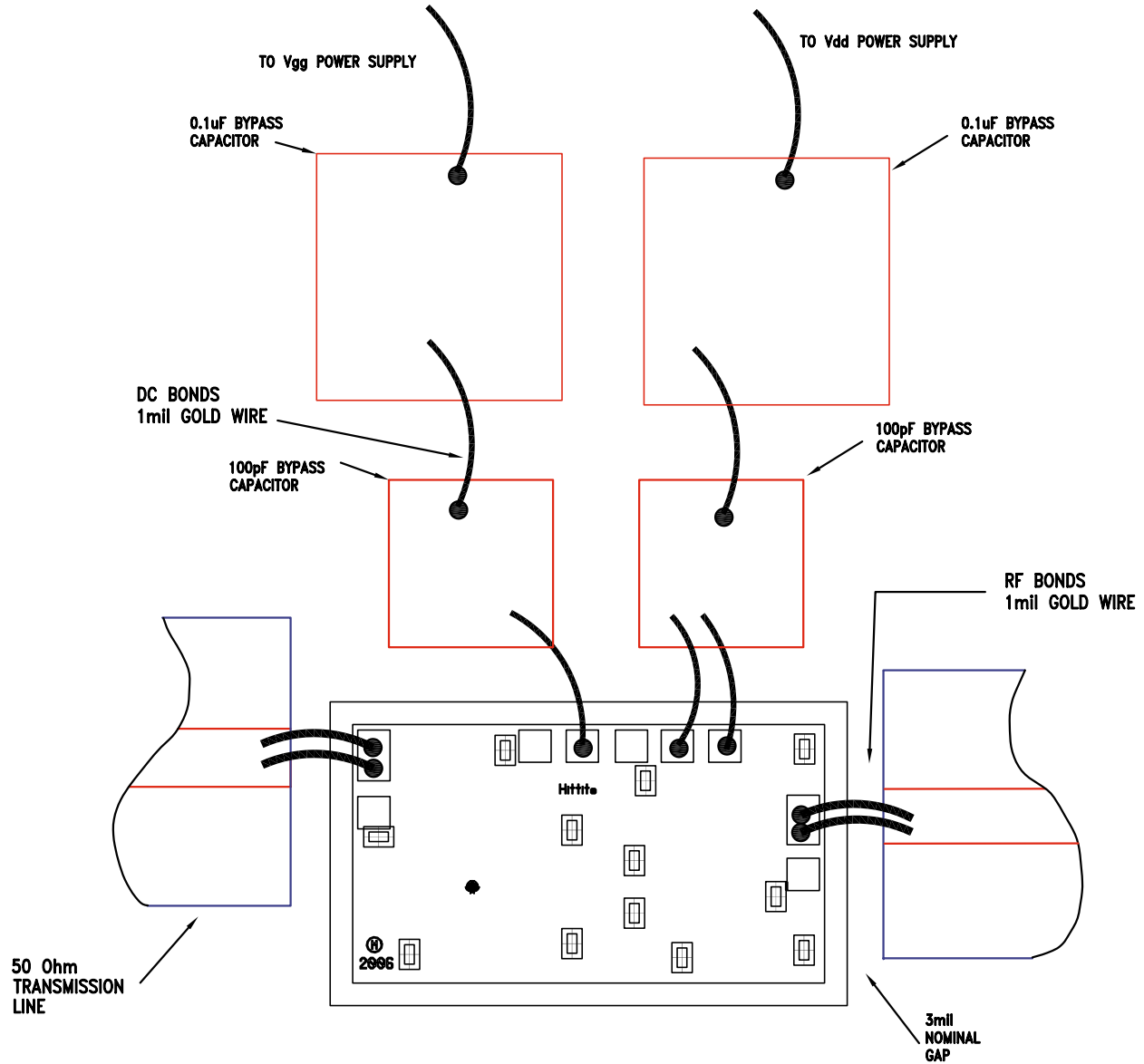
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Assembly Diagram



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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). 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 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 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).

