



## GaAs InGaP HBT MMIC POWER AMPLIFIER, 5 - 6 GHz

### Typical Applications

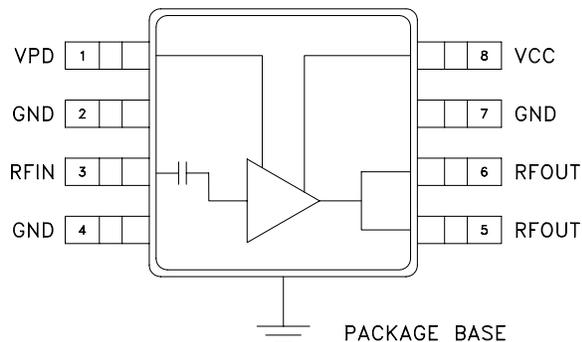
The HMC406MS8G(E) is ideal for:

- WiMAX & WiLAN
- DSRC
- Military & Maritime
- Private Mobile Radio
- UNII & ISM

### Features

- Gain: 17 dB
- Saturated Power: +29 dBm
- 38% PAE
- Supply Voltage: +5V
- Power Down Capability
- Low External Part Count

### Functional Diagram



### General Description

The HMC406MS8G(E) is a high efficiency GaAs InGaP Heterojunction Bipolar Transistor (HBT) MMIC Power amplifier which operates between 5 and 6 GHz. The amplifier is packaged in a low cost, surface mount 8 leaded package with an exposed base for improved RF and thermal performance. With a minimum of external components, the amplifier provides 17 dB of gain and +29 dBm of saturated power at 38% PAE from a +5V supply voltage. Vpd can be used for full power down or RF output power/current control.

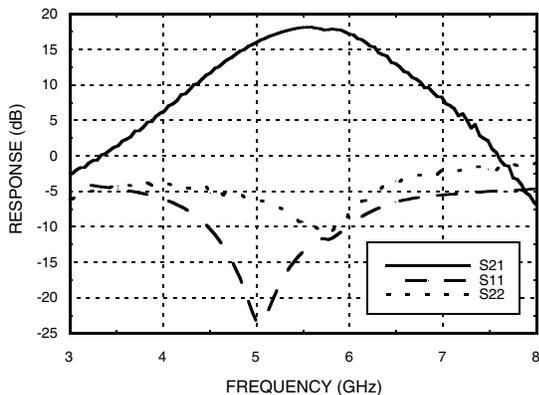
### Electrical Specifications, $T_A = +25^\circ C$ , $V_s = 5V$ , $V_{pd} = 5V$

| Parameter                                | Min.        | Typ. | Max.        | Min.      | Typ.        | Max. | Units  |
|--|-------------|------|-------------|-----------|-------------|------|--------|
| Frequency Range                          | 5 - 6       |      |             | 5.7 - 5.9 |             |      | GHz    |
| Gain                                     | 13          | 16   | 21          | 14        | 17          | 21   | dB     |
| Gain Variation Over Temperature          |             | 0.03 | 0.04        |           | 0.03        | 0.04 | dB/ °C |
| Input Return Loss                        |             | 10   |             |           | 11          |      | dB     |
| Output Return Loss                       |             | 8    |             |           | 9           |      | dB     |
| Output Power for 1 dB Compression (P1dB) | 21          | 24   |             | 24        | 27          |      | dBm    |
| Saturated Output Power (Psat)            |             | 27   |             |           | 29          |      | dBm    |
| Output Third Order Intercept (IP3)       | 34          | 38   |             | 34        | 38          |      | dBm    |
| Noise Figure                             |             | 6.0  |             |           | 6.0         |      | dB     |
| Supply Current (Icq)                     | Vpd = 0V/5V |      | 0.002 / 300 |           | 0.002 / 300 |      | mA     |
| Control Current (Ipd)                    | Vpd = 5V    |      | 7           |           | 7           |      | mA     |
| Switching Speed                          | tON, tOFF   |      | 35          |           | 35          |      | ns     |

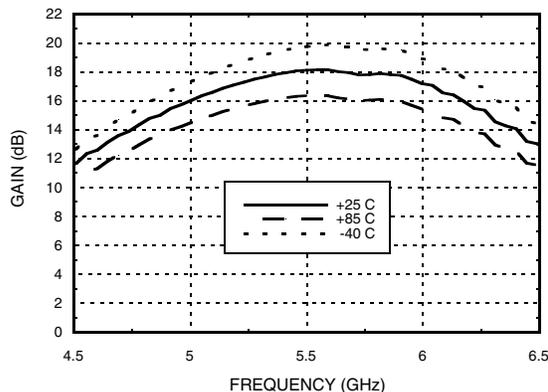


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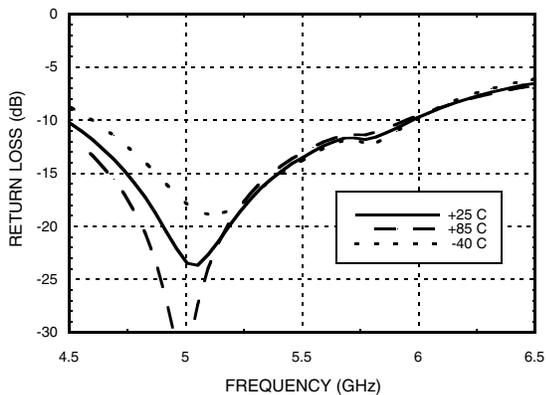
**Broadband Gain & Return Loss**



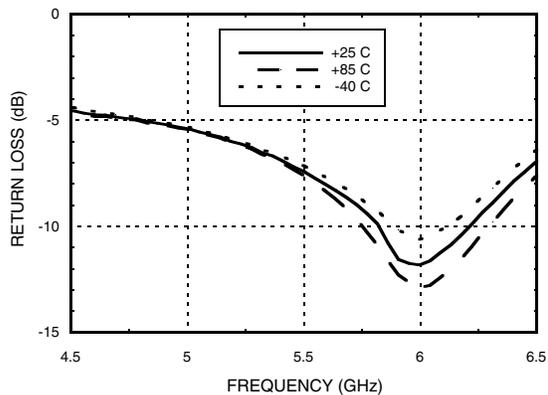
**Gain vs. Temperature**



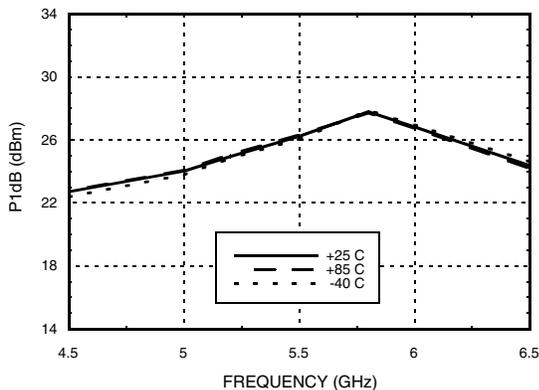
**Input Return Loss vs. Temperature**



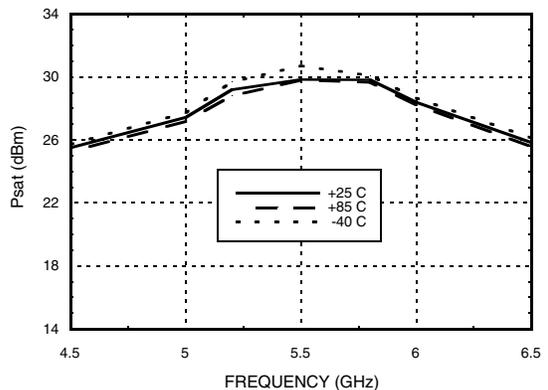
**Output Return Loss vs. Temperature**



**P1dB vs. Temperature**



**Psat vs. Temperature**



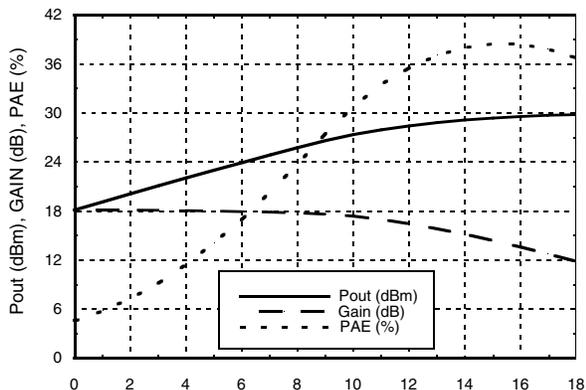
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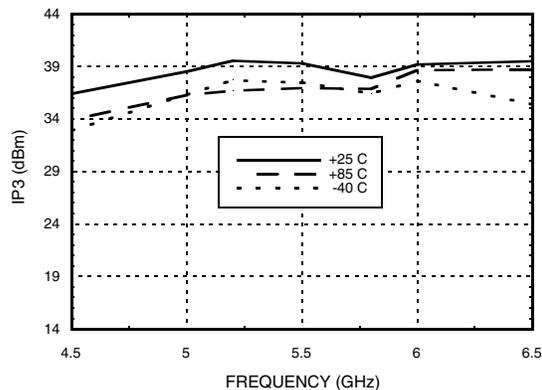


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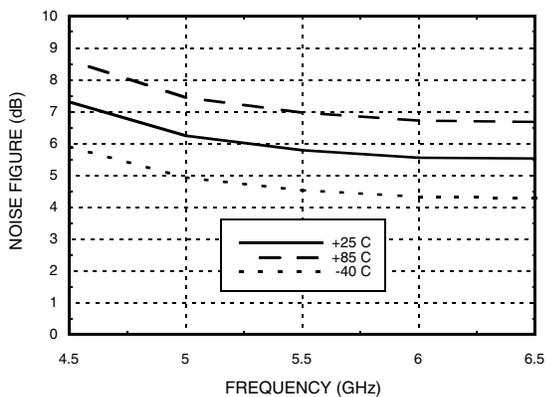
**Power Compression @ 5.8 GHz**



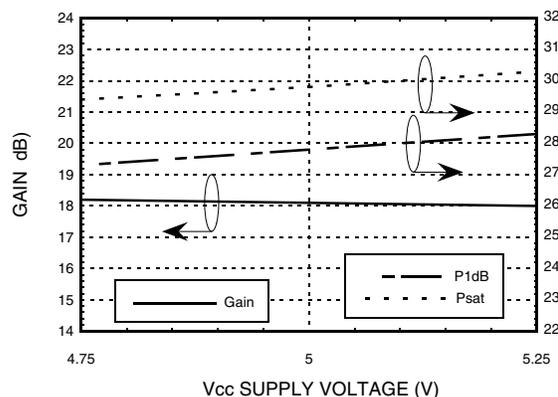
**Output IP3 vs. Temperature**



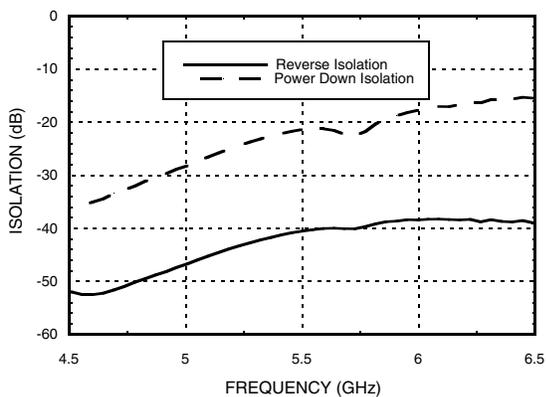
**Noise Figure vs. Temperature**



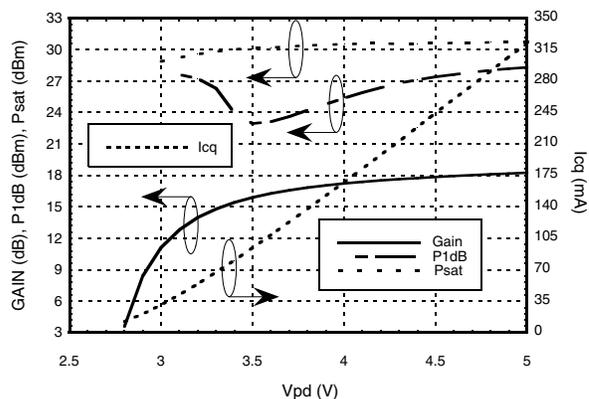
**Gain & Power vs. Supply Voltage**



**Reverse Isolation vs. Temperature**



**Gain, Power & Quiescent Supply Current vs. Vpd @ 5.8 GHz**



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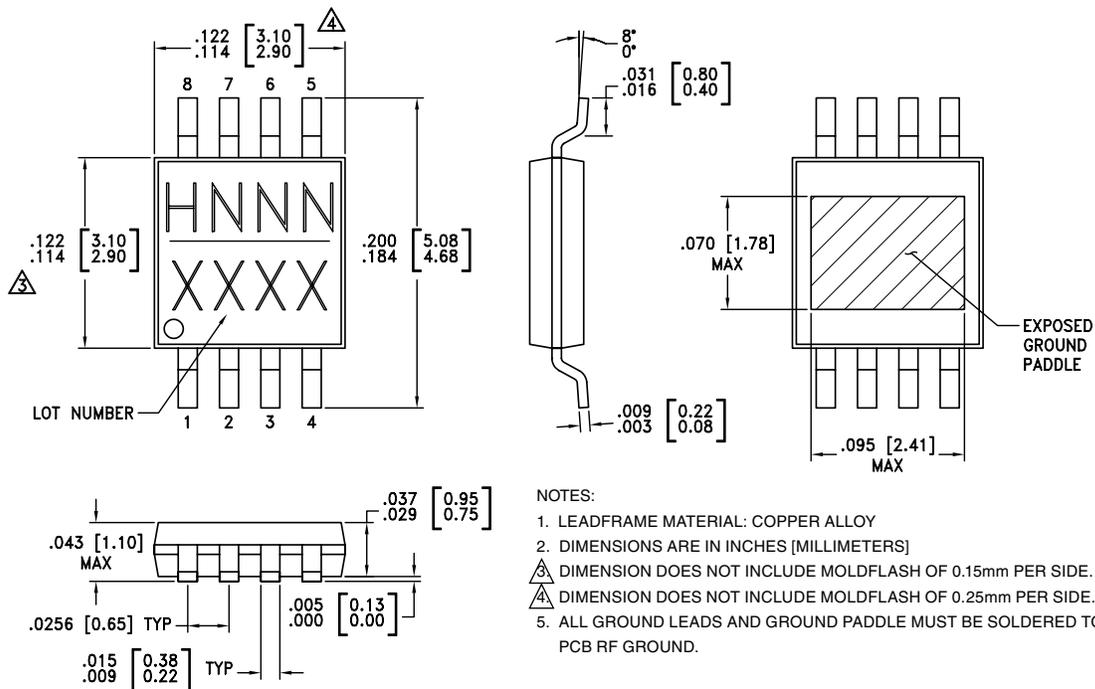
### Absolute Maximum Ratings

|   |                |
|---|----------------|
| Collector Bias Voltage (Vcc)  | +5.5V          |
| Control Voltage (Vpd)   | +5.5V          |
| RF Input Power (RFIN)(Vs = Vpd = +5V)                                     | +20 dBm        |
| Junction Temperature  | 150 °C         |
| Continuous P <sub>diss</sub> (T = 85 °C)<br>(derate 32 mW/°C above 85 °C) | 2.1 W          |
| Thermal Resistance<br>(junction to ground paddle)                         | 31 °C/W        |
| Storage Temperature   | -65 to +150 °C |
| Operating Temperature   | -40 to +85° C  |



ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS

### Outline Drawing



### Package Information

| Part Number | Package Body Material                               | Lead Finish   | MSL Rating          | Package Marking <sup>[3]</sup> |
|-------------|---|---------------|---------------------|--------------------------------|
| HMC406MS8G  | Low Stress Injection Molding Plastic                | Sn/Pb Solder  | MSL1 <sup>[1]</sup> | H406<br>XXXX                   |
| HMC406MS8GE | RoHS-compliant Low Stress Injection Molding Plastic | 100% matte Sn | MSL1 <sup>[2]</sup> | H406<br>XXXX                   |

[1] Max peak reflow temperature of 235 °C

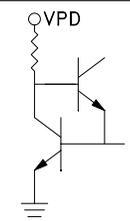
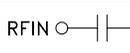
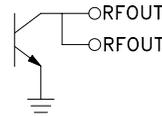
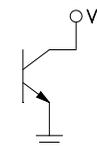
[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX



## GaAs InGaP HBT MMIC POWER AMPLIFIER, 5 - 6 GHz

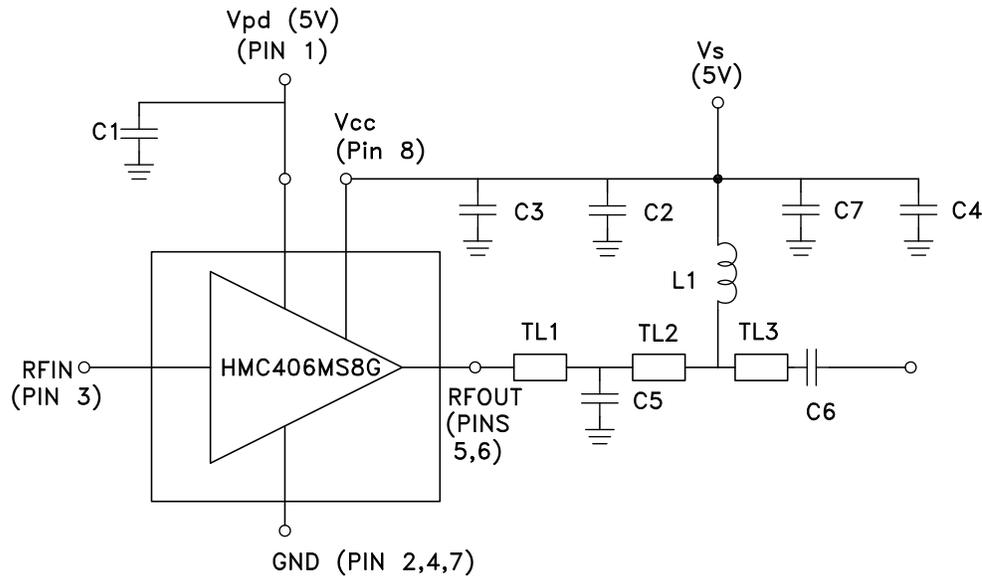
### Pin Descriptions

| Pin Number | Function | Description  | Interface Schematic  |
|------------|----------|--|--|
| 1          | Vpd      | Power Control Pin. For maximum power, this pin should be connected to 5V. A higher voltage is not recommended. For lower idle current, this voltage can be reduced.          |   |
| 2, 4, 7    | GND      | Ground: Backside of package has exposed metal ground slug that must be connected to ground thru a short path. Vias under the device are required.                            |   |
| 3          | RFIN     | This pin is AC coupled and matched to 50 Ohms.   |   |
| 5, 6       | RFOUT    | RF output and bias for the output stage. The power supply for the output device needs to be supplied to these pins.  |   |
| 8          | Vcc      | Power supply voltage for the first amplifier stage. An external bypass capacitor of 330 pF is required. This capacitor should be placed as close to the devices as possible. |  |



## GaAs InGaP HBT MMIC POWER AMPLIFIER, 5 - 6 GHz

### Application Circuit



Note 1: C3 should be located < 0.020" from Pin 8 (Vcc)

Note 2: C2 should be located < 0.020" from L1.

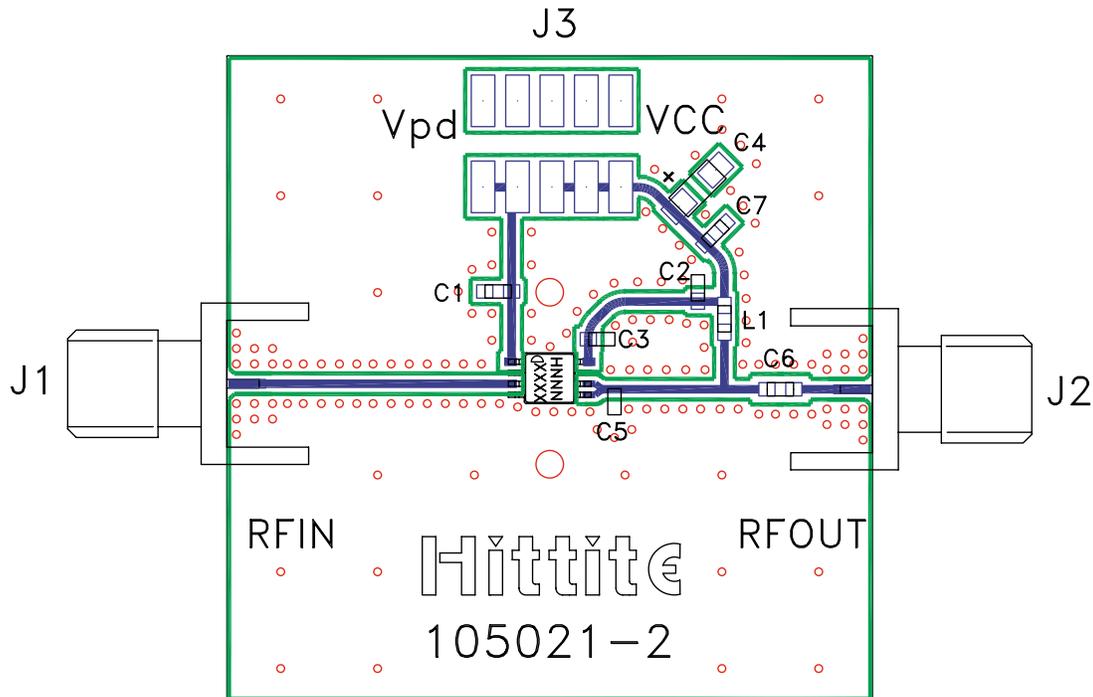
|                             | TL1  | TL2  | TL3  |
|-----------------------------|--|--|--|
| Impedance                   | 50 ohm   | 50 ohm   | 50 ohm                                       |
| Physical Length             | 0.0443"  | 0.2556"  | 0.1000"                                      |
| Electrical Length @ 5.5 GHz | 11.3°  | 65.2°  | 25.5°  |
| Measurement                 | Edge of package pin to center of capacitor C5. | Center of capacitor C5 to center of bias line. | Center of bias line to edge of capacitor C6. |

PCB Material: 10 mil Rogers 4350 or Arlon 25FR



## GaAs InGaP HBT MMIC POWER AMPLIFIER, 5 - 6 GHz

### Evaluation PCB



### List of Materials for Evaluation PCB 104989 [1]

| Item    | Description                     |
|---------|---------------------------------|
| J1 - J2 | PCB Mount SMA RF Connector      |
| J3      | 2mm DC Header                   |
| C1 - C3 | 330 pF Capacitor, 0603 Pkg.     |
| C4      | 2.2 $\mu$ F Capacitor, Tantalum |
| C5      | 0.6 pF Capacitor, 0603 Pkg.     |
| C6      | 1.6 pF Capacitor, 0603 Pkg.     |
| C7      | 100 pF Capacitor, 0603 Pkg.     |
| L1      | 3.9 nH Inductor, 0603 Pkg.      |
| U1      | HMC406MS8G(E) Amplifier         |
| PCB [2] | 105021 Eval Board               |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Roger 4350 or Arlon 25FR

The circuit board used in the application should use RF circuit design techniques. Signal lines should have 50 Ohm impedance while the package ground leads and exposed paddle should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation board should be mounted to an appropriate heat sink. The evaluation circuit board shown is available from Hittite upon request.

**Notes:****HMC406MS8G / 406MS8GE**

v06.0611

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