



## InGaP HBT 1 WATT POWER AMPLIFIER, 1.7 - 2.2 GHz

### Typical Applications

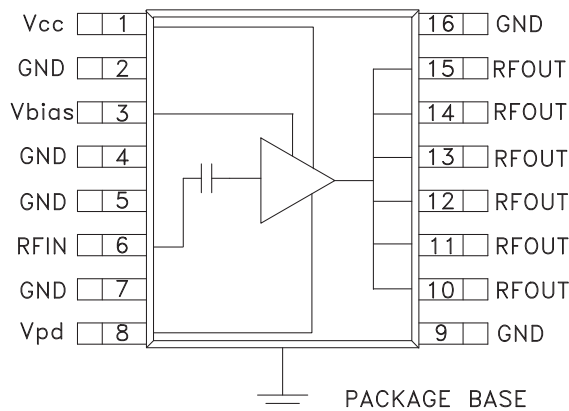
The HMC457QS16G / HMC457QS16GE is ideal for applications requiring a high dynamic range amplifier:

- CDMA & W-CDMA
- GSM, GPRS & Edge
- Base Stations & Repeaters

### Features

Output IP3: +46 dBm  
Gain: 27 dB @ 1900 MHz  
48% PAE @ +32 dBm Pout  
+25 dBm W-CDMA Channel Power  
@ -50 dBc ACPR  
Integrated Power Control (Vpd)  
QSOP16G SMT Package: 29.4 mm<sup>2</sup>  
Included in the HMC-DK002 Designer's Kit

### Functional Diagram



### General Description

The HMC457QS16G & HMC457QS16GE are high dynamic range GaAs InGaP Heterojunction Bipolar Transistor (HBT) 1 watt MMIC power amplifiers operating between 1.7 and 2.2 GHz. Packaged in a miniature 16 lead QSOP plastic package, the amplifier gain is typically 27 dB from 1.7 to 2.0 GHz and 25 dB from 2.0 to 2.2 GHz. Utilizing a minimum number of external components, the amplifier output IP3 can be optimized to +45 dBm. The power control (Vpd) can be used for full power down or RF output power/current control. The high output IP3 and PAE make the HMC457QS16G & HMC457QS16GE ideal power amplifiers for Cellular/3G base station & repeater applications.

### Electrical Specifications, $T_A = +25^\circ\text{C}$ , $V_S = +5\text{V}$ , $V_{pd} = +5\text{V}$ , $V_{bias} = +5\text{V}$ [1]

| Parameter                               | Min. | Typ.        | Max.  | Min.        | Typ.  | Max.  | Units   |
|-----------------------------------------|------|-------------|-------|-------------|-------|-------|---------|
| Frequency Range                         |      | 1710 - 1990 |       | 2010 - 2170 |       |       | MHz     |
| Gain                                    | 24   | 27          |       | 22          | 25    |       | dB      |
| Gain Variation Over Temperature         |      | 0.025       | 0.035 |             | 0.025 | 0.035 | dB / °C |
| Input Return Loss                       |      | 11          |       |             | 11    |       | dB      |
| Output Return Loss                      |      | 8           |       |             | 5     |       | dB      |
| Output Power for 1dB Compression (P1dB) | 26   | 29          |       | 27.5        | 30.5  |       | dBm     |
| Saturated Output Power (Psat)           |      | 32.5        |       |             | 32    |       | dBm     |
| Output Third Order Intercept (IP3) [2]  | 42   | 45          |       | 42          | 45    |       | dBm     |
| Noise Figure                            |      | 6           |       |             | 5     |       | dB      |
| Supply Current (Icq)                    |      | 500         |       |             | 500   |       | mA      |
| Control Current (Ipd)                   |      | 4           |       |             | 4     |       | mA      |
| Bias Current (Vbias)                    |      | 10          |       |             | 10    |       | mA      |

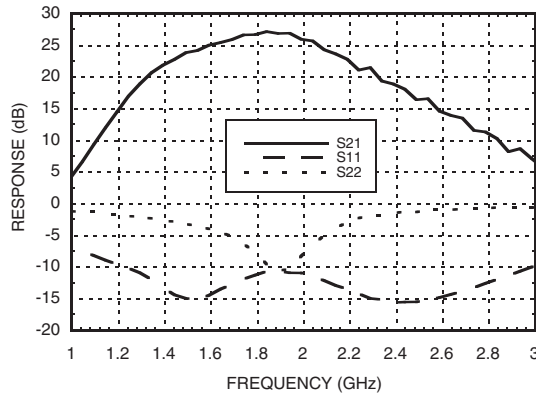
[1] Specifications and data reflect HMC457QS16G measured using the respective application circuits for each designated frequency band found herein. Contact the HMC Applications Group for assistance in optimizing performance for your application.

[2] Two-tone output power of +15 dBm per tone, 1 MHz spacing.

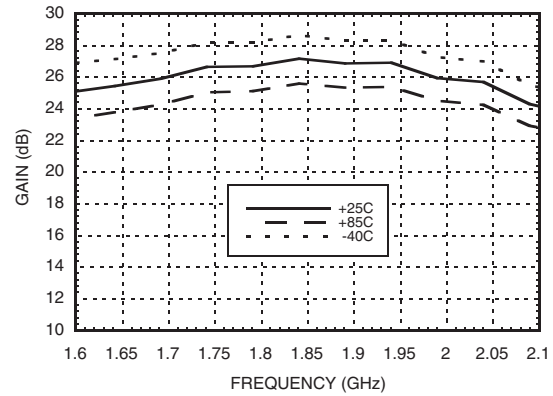


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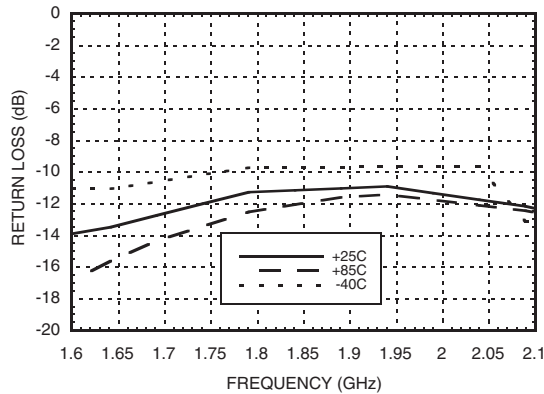
**Broadband Gain  
& Return Loss @ 1900 MHz**



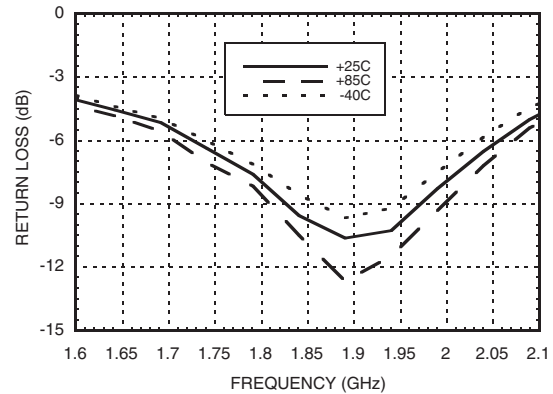
**Gain vs. Temperature @ 1900 MHz**



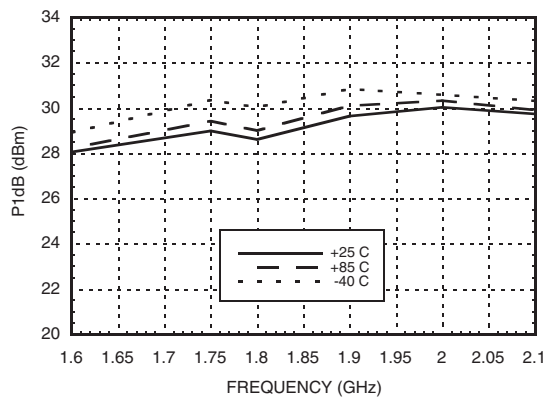
**Input Return Loss  
vs. Temperature @ 1900 MHz**



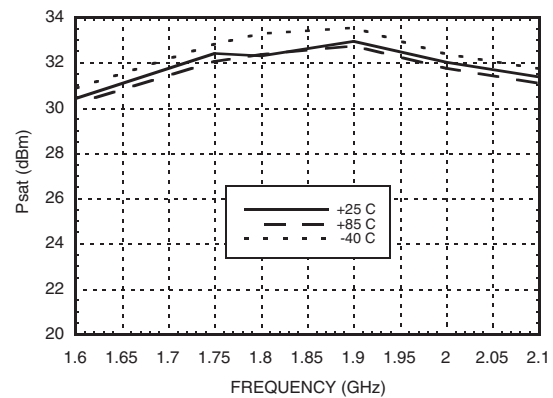
**Output Return Loss  
vs. Temperature @ 1900 MHz**

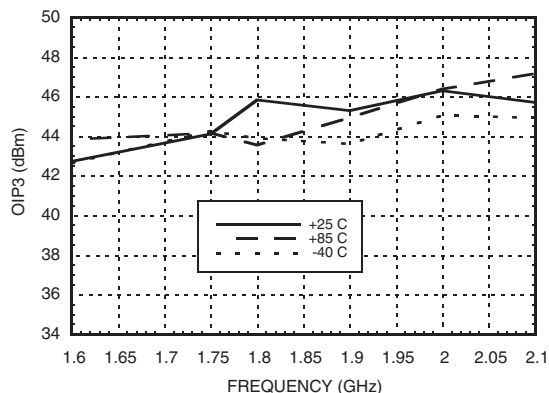
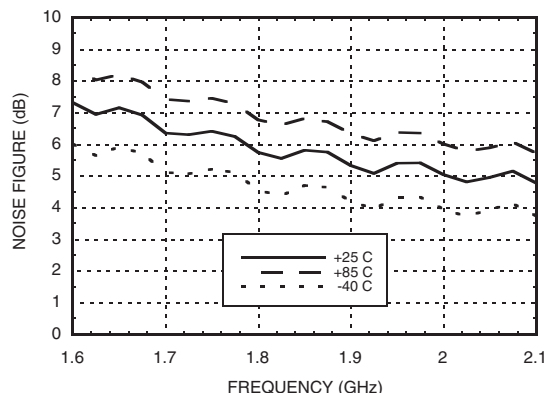
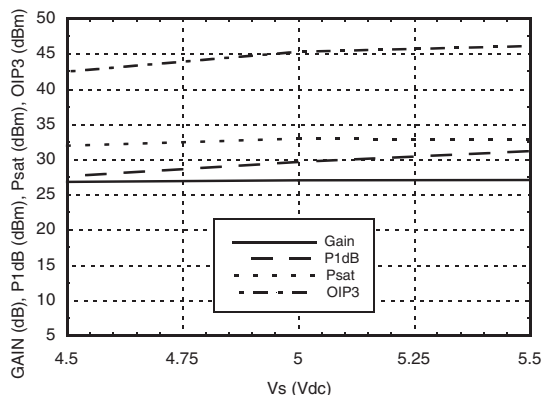
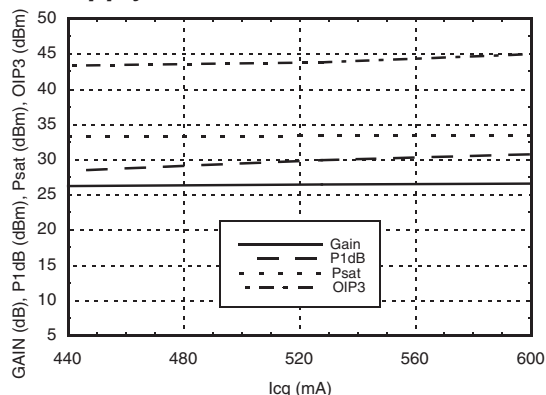
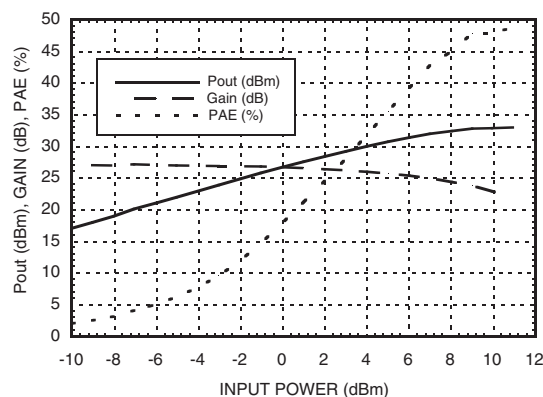
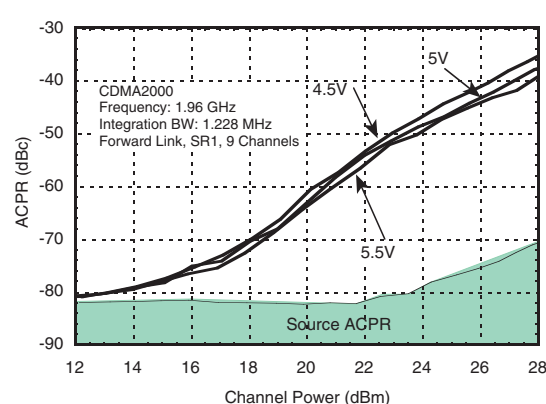


**P1dB vs. Temperature @ 1900 MHz**



**Psat vs. Temperature @ 1900 MHz**




**InGaP HBT 1 WATT POWER  
AMPLIFIER, 1.7 - 2.2 GHz**
**Output IP3 vs. Temperature @ 1900 MHz**

**Noise Figure vs.  
Temperature @ 1900 MHz**

**Gain, Power & IP3  
vs. Supply Voltage @ 1900 MHz**

**Gain, Power & IP3  
vs. Supply Current @ 1900 MHz\***

**Power Compression @ 1900 MHz**

**ACPR vs. Supply Voltage @ 1960 MHz  
CDMA 2000, 9 Channels Forward**


\* Icq is controlled by varying Vpd.

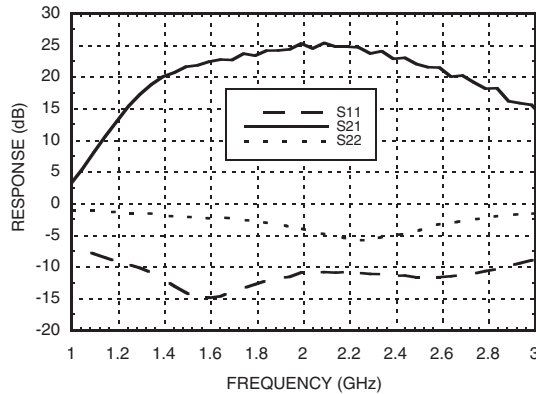
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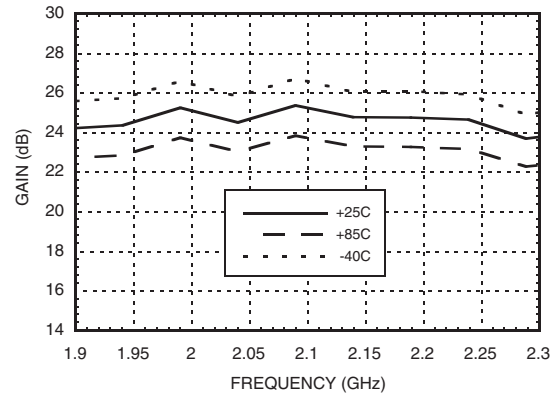


## InGaP HBT 1 WATT POWER AMPLIFIER, 1.7 - 2.2 GHz

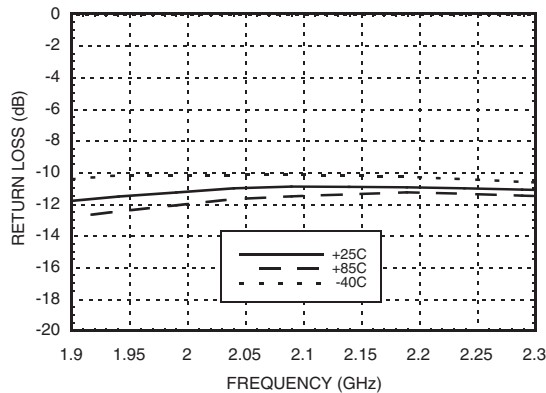
### Broadband Gain and Return Loss @ 2100 MHz



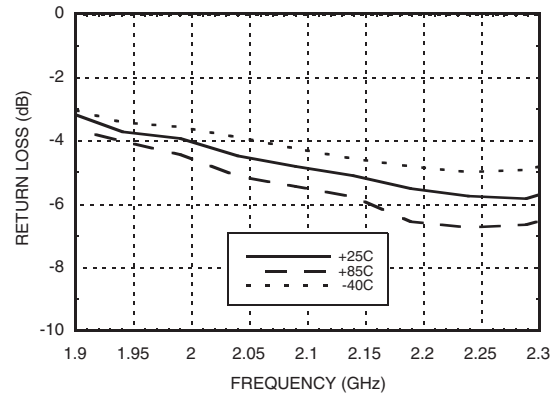
### Gain vs. Temperature @ 2100 MHz



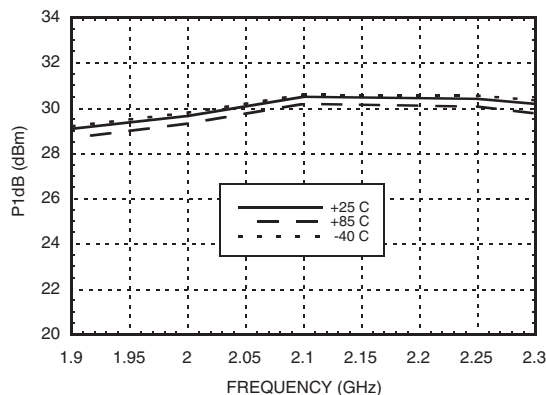
### Input Return Loss vs. Temperature @ 2100 MHz



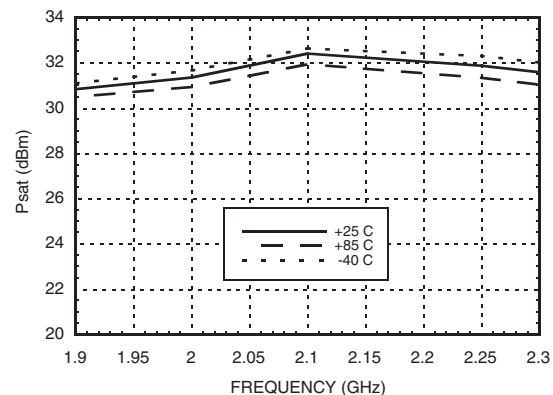
### Output Return Loss vs. Temperature @ 2100 MHz

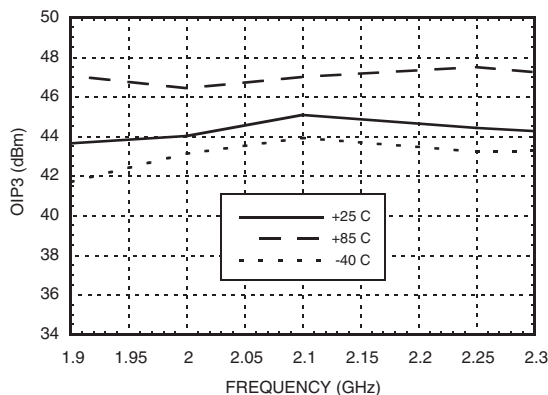
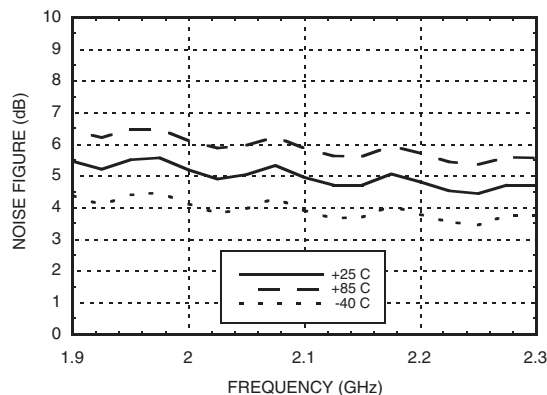
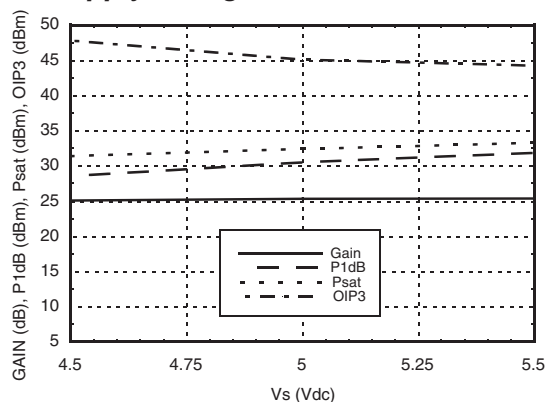
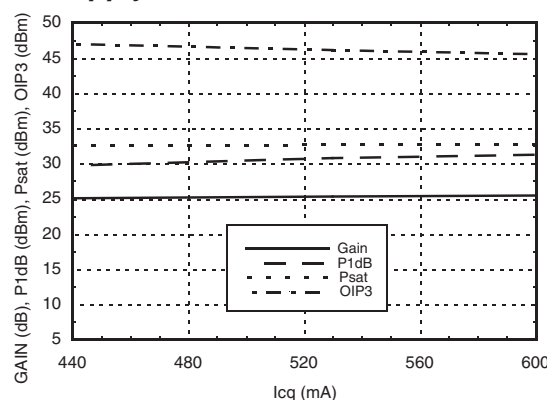
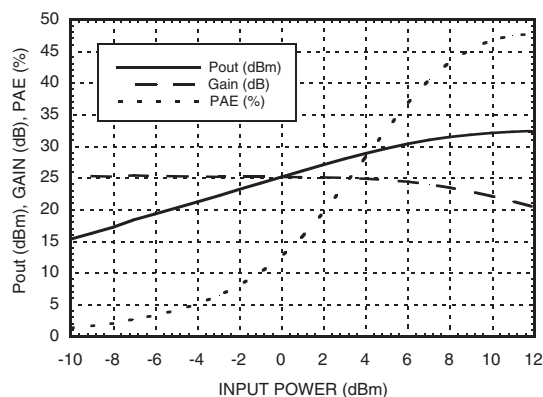
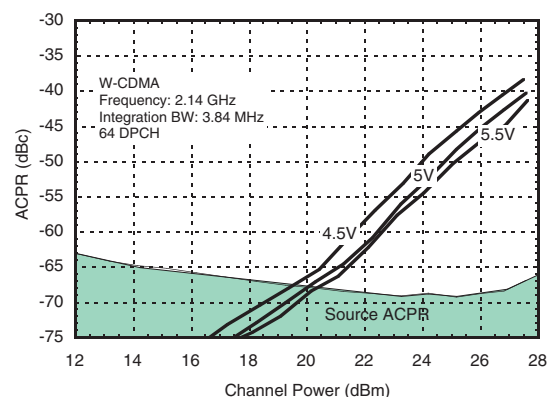


### P1dB vs. Temperature @ 2100 MHz



### Psat vs. Temperature @ 2100 MHz

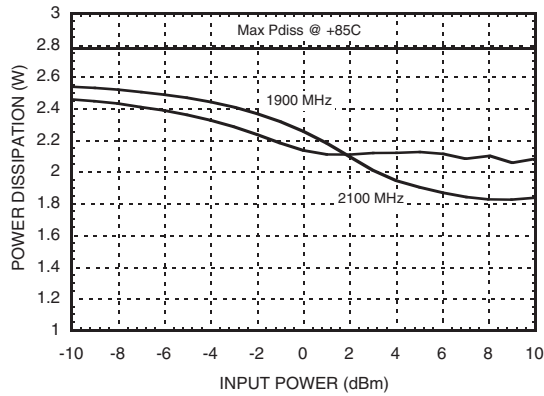



**InGaP HBT 1 WATT POWER  
AMPLIFIER, 1.7 - 2.2 GHz**
**Output IP3  
vs. Temperature @ 2100 MHz**

**Noise Figure  
vs. Temperature @ 2100 MHz**

**Gain, Power & IP3  
vs. Supply Voltage @ 2100 MHz**

**Gain, Power & IP3  
vs. Supply Current @ 2100 MHz\***

**Power Compression @ 2100 MHz**

**ACPR vs. Supply Voltage @ 2140 MHz  
W-CDMA, 64 DPCH (Uplink)**


\*Icq is controlled by varying Vpd

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**InGaP HBT 1 WATT POWER  
AMPLIFIER, 1.7 - 2.2 GHz**
**Power Dissipation**

**Typical Supply Current  
vs. Supply Voltage**

| Vs (V) | Icq (mA) |
|--------|----------|
| 4.5    | 400      |
| 5.0    | 510      |
| 5.5    | 620      |

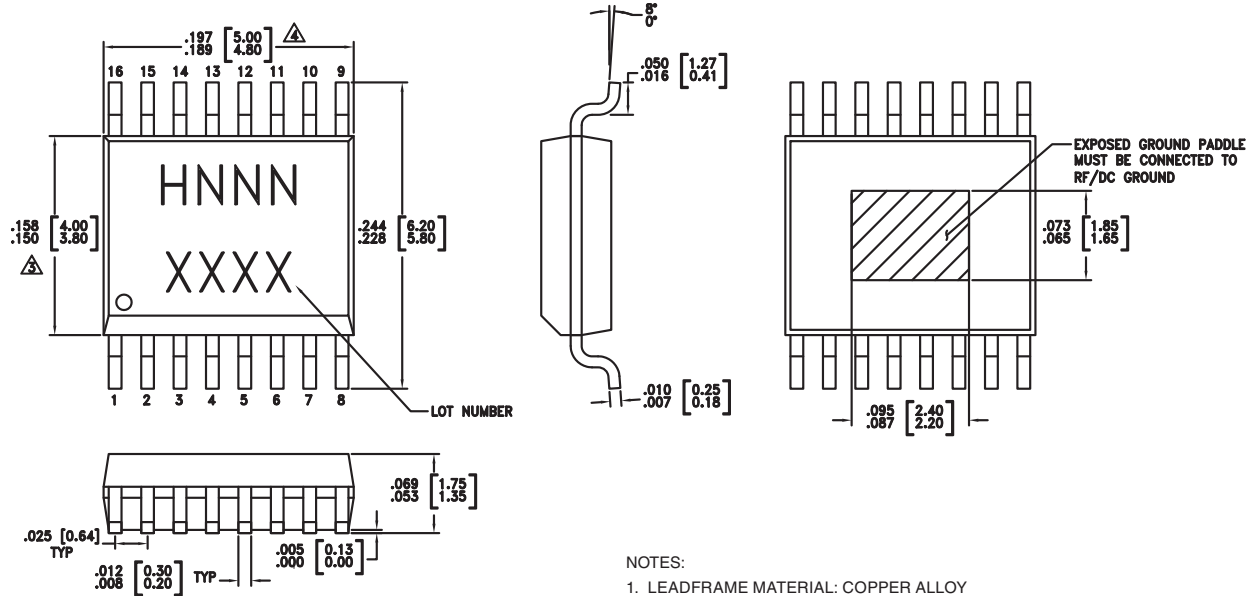
**Absolute Maximum Ratings**

|                                                                |                |
|----------------------------------------------------------------|----------------|
| Collector Bias Voltage (Vcc)                                   | +6 Vdc         |
| Control Voltage (Vpd)                                          | +5.4 Vdc       |
| RF Input Power (RFIN)(Vs = Vpd = +5 Vdc)                       | +15 dBm        |
| Junction Temperature                                           | 150 °C         |
| Continuous Pdis (T = 85 °C)<br>(derate 42.9 mW/°C above 85 °C) | 2.78 W         |
| Thermal Resistance<br>(junction to ground paddle)              | 23.3 °C/W      |
| Storage Temperature                                            | -65 to +150 °C |
| Operating Temperature                                          | -40 to +85 °C  |



**ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS**

**11**
**LINEAR & POWER AMPLIFIERS - SMT**

**InGaP HBT 1 WATT POWER  
AMPLIFIER, 1.7 - 2.2 GHz**
**Outline Drawing**

**Package Information**

| Part Number  | Package Body Material                              | Lead Finish   | MSL Rating          | Package Marking <sup>[3]</sup> |
|--------------|----------------------------------------------------|---------------|---------------------|--------------------------------|
| HMC457QS16G  | Low Stress Injection Molded Plastic                | Sn/Pb Solder  | MSL1 <sup>[1]</sup> | H457<br>XXXX                   |
| HMC457QS16GE | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 <sup>[2]</sup> | H457<br>XXXX                   |

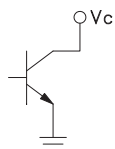
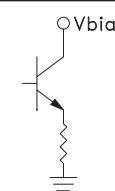
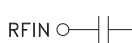
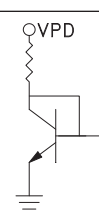
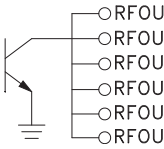
[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX



### Pin Descriptions

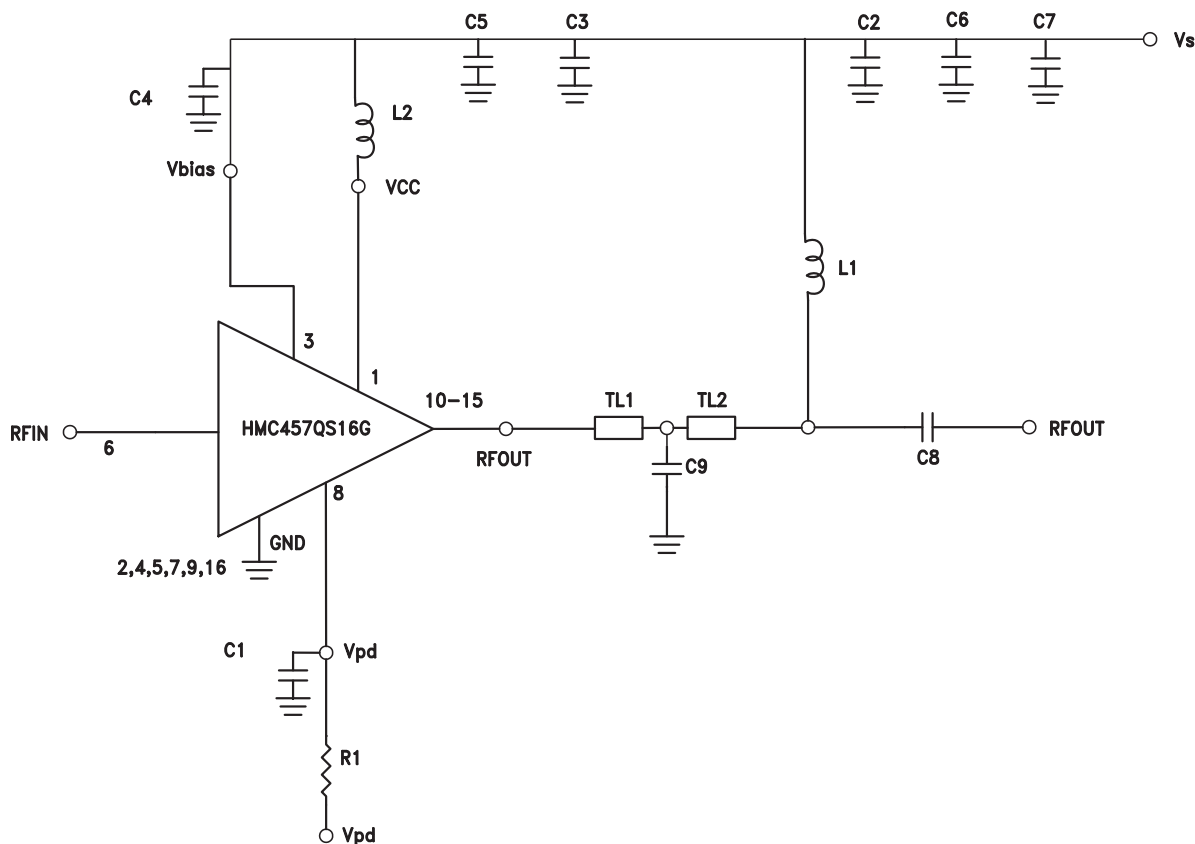
| Pin Number        | Function | Description                                                                                                                                                          | Interface Schematic                                                                   |
|-------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1                 | Vcc      | Power supply voltage for the first amplifier stage. External bypass capacitors are required as shown in the application schematic.                                   |    |
| 2, 4, 5, 7, 9, 16 | GND      | Ground: Backside of package has exposed metal ground slug that must also be connected to RF/DC ground. Vias under the device are required.                           |    |
| 3                 | Vbias    | Power Supply for Bias Circuit                                                                                                                                        |    |
| 6                 | RFIN     | This pin is AC coupled and matched to 50 Ohms                                                                                                                        |   |
| 8                 | 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. |  |
| 10 - 15           | RFOUT    | RF output and DC bias for the output stage.                                                                                                                          |  |





### 1900 & 2100 MHz Application Circuit

This circuit was used to specify the performance for 1900 & 2100 MHz operation. Contact the HMC Applications Group for assistance in optimizing performance for your application.

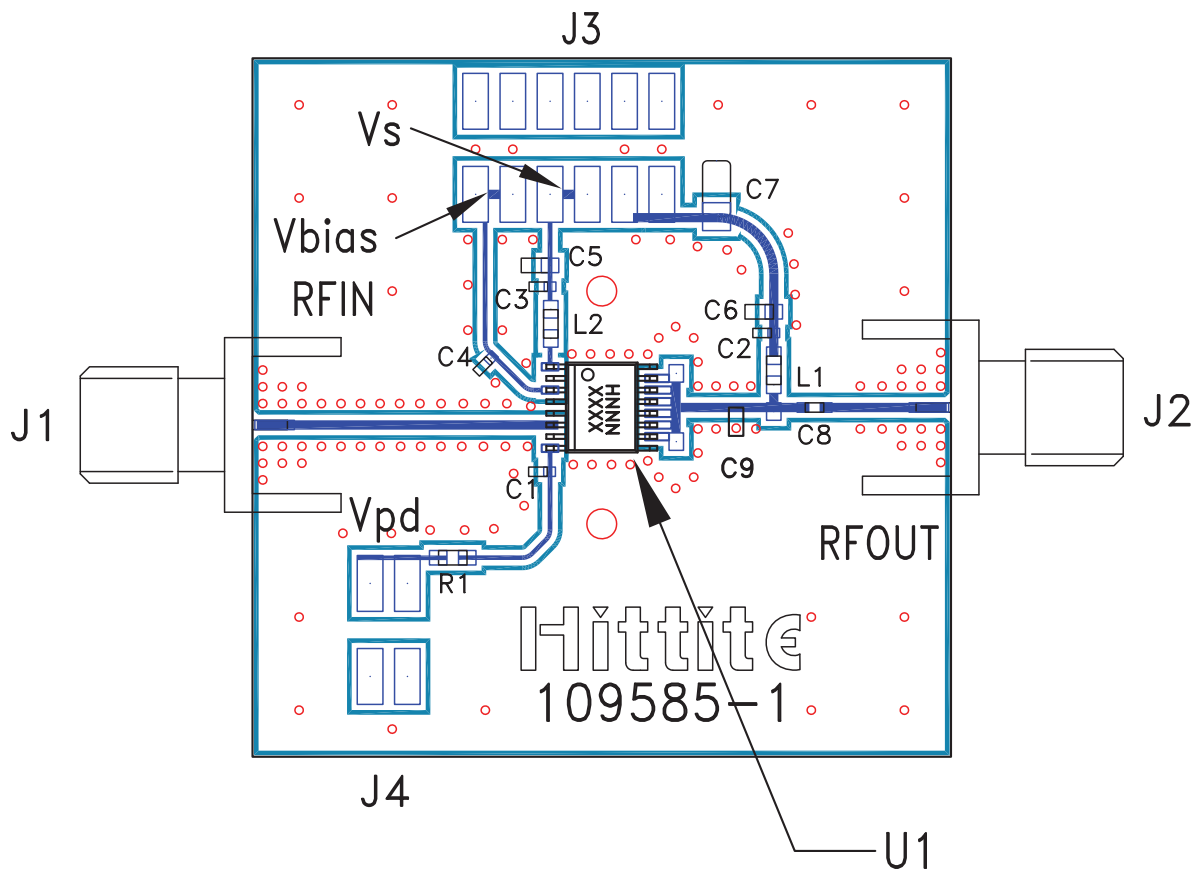


|                                             | TL1    | TL2    |
|---------------------------------------------|--------|--------|
| Impedance                                   | 50 Ohm | 50 Ohm |
| Physical Length                             | 0.170" | 0.080" |
| Electrical Length                           | 20°    | 9°     |
| PCB Material: 10 mil Rogers 4350, Er = 3.48 |        |        |

| Recommended Component Values | 1900 MHz    | 2100 MHz    |
|------------------------------|-------------|-------------|
| C1 - C4                      | 100 pF      | 100 pF      |
| C5, C6                       | 1000 pF     | 1000 pF     |
| C7                           | 2.2 $\mu$ F | 2.2 $\mu$ F |
| C8                           | 33 pF       | 33 pF       |
| C9                           | 3.9 pF      | 2.7 pF      |
| L1, L2                       | 3.9 nH      | 3.9 nH      |
| R1                           | 160 Ohm     | 160 Ohm     |



**Evaluation PCB**



**List of Materials for Evaluation PCB 106043-1900, 110171-2100 [1]**

| Item    | Description                            |
|---------|----------------------------------------|
| J1, J2  | PCB Mount SMA Connector                |
| J3, J4  | 2 mm DC Header                         |
| C1 - C4 | 100 pF Capacitor, 0402 Pkg.            |
| C5, C6  | 1000 pF Capacitor, 0603 Pkg.           |
| C7      | 2.2 $\mu$ F Capacitor, Tantalum        |
| C8      | 33 pF Capacitor, 0402 Pkg.             |
| C9      | 3.9 pF Capacitor, 0603 Pkg. - 1900 MHz |
| C9      | 2.7 pF Capacitor, 0603 Pkg. - 2100 MHz |
| L1, L2  | 3.9 nH Inductor, 0603 Pkg.             |
| R1      | 160 Ohm Resistor, 0603 Pkg.            |
| U1      | HMC457QS16G / HMC457QS16GE             |
| PCB [2] | 109585 Evaluation PCB, 10 mils         |

[1] Reference one of these numbers when ordering complete evaluation PCB depending on frequency of operation.

[2] Circuit Board Material: Rogers 4350, Er = 3.48

The circuit board used in this 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.

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