

# HMC591LP5 / 591LP5E

## GaAs PHEMT MMIC 2 WATT POWER AMPLIFIER, 6.0 - 9.5 GHz

### Typical Applications

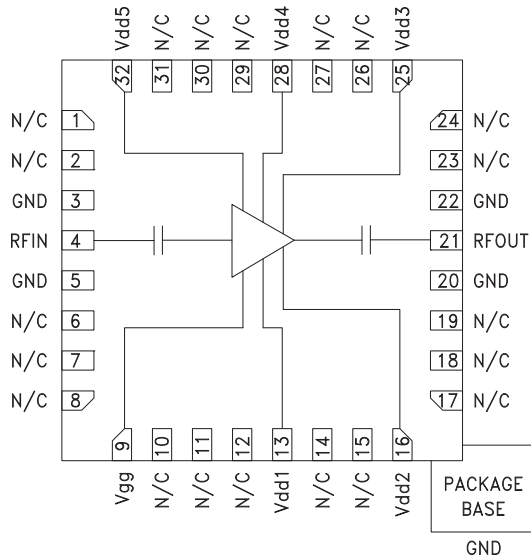
The HMC591LP5 / HMC591LP5E is ideal for use as a power amplifier for:

- Point-to-Point Radios
- Point-to-Multi-Point Radios
- Test Equipment & Sensors
- Military End-Use
- Space

### Features

Saturated Output Power: +33 dBm @ 20% PAE  
Output IP3: +41 dBm  
Gain: 18 dB  
DC Supply: +7V @ 1340 mA  
50 Ohm Matched Input/Output  
QFN Leadless SMT Packages, 25 mm<sup>2</sup>

### Functional Diagram



### General Description

The HMC591LP5 & HMC591LP5E are high dynamic range GaAs PHEMT MMIC 2 Watt Power Amplifiers which operate from 6 to 9.5 GHz. The amplifier provides 18 dB of gain, +33 dBm of saturated power, and 19% PAE from a +7V supply. This 50 Ohm matched amplifier does not require any external components and the RF I/Os are DC blocked for robust operation. For applications which require optimum OIP3, Idd should be set for 940 mA, to yield +41 dBm OIP3. For applications which require optimum output P1dB, Idd should be set for 1340 mA, to yield +33 dBm Output P1dB.

### Electrical Specifications, $T_A = +25^\circ \text{C}$ , $V_{dd} = +7\text{V}$ , $I_{dd} = 1340 \text{ mA}$ <sup>[1]</sup>

| Parameter                                         | Min.  | Typ. | Max. | Min.    | Typ. | Max. | Units  |
|---------------------------------------------------|-------|------|------|---------|------|------|--------|
| Frequency Range                                   | 6 - 8 |      |      | 6 - 9.5 |      |      | GHz    |
| Gain                                              | 16    | 19   |      | 15      | 18   |      | dB     |
| Gain Variation Over Temperature                   |       | 0.05 |      |         | 0.05 |      | dB/ °C |
| Input Return Loss                                 |       | 14   |      |         | 12   |      | dB     |
| Output Return Loss                                |       | 12   |      |         | 10   |      | dB     |
| Output Power for 1 dB Compression (P1dB)          | 30    | 32   |      | 30      | 33   |      | dBm    |
| Saturated Output Power (Psat)                     |       | 32.5 |      |         | 33   |      | dBm    |
| Output Third Order Intercept (IP3) <sup>[2]</sup> |       | 41   |      |         | 41   |      | dBm    |
| Supply Current (Idd)                              |       | 1340 |      |         | 1340 |      | mA     |

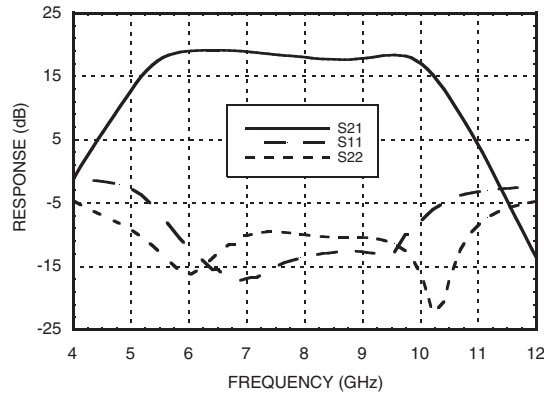
[1] Adjust Vg between -2 to 0V to achieve Idd= 1340 mA typical.

[2] Measurement taken at 7V @ 940mA, Pin/Tone = -15 dBm

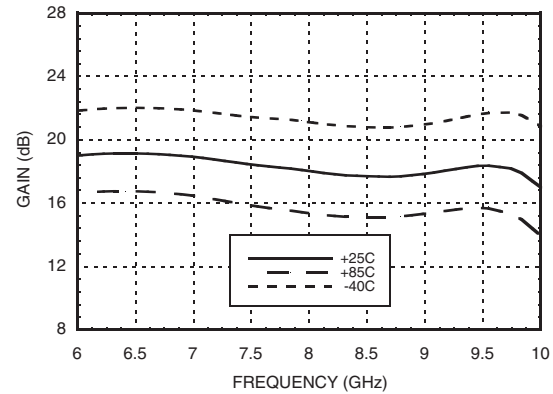
## HMC591LP5 / 591LP5E

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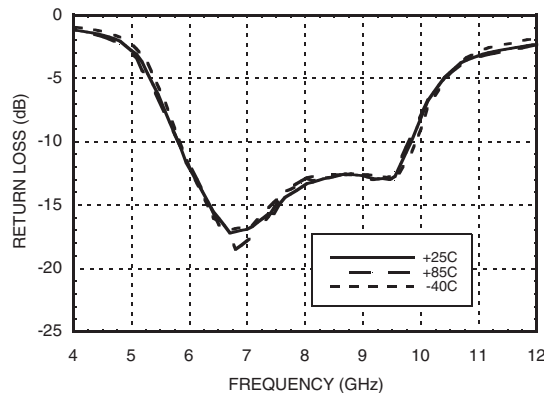
**Broadband Gain & Return Loss**



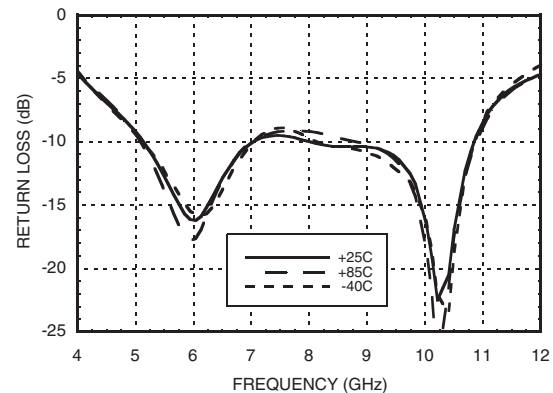
**Gain vs. Temperature**



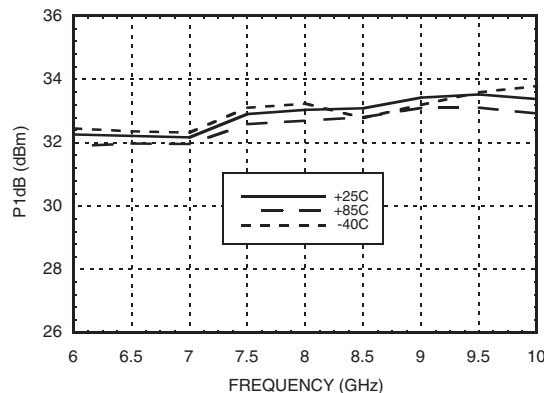
**Input Return Loss vs. Temperature**



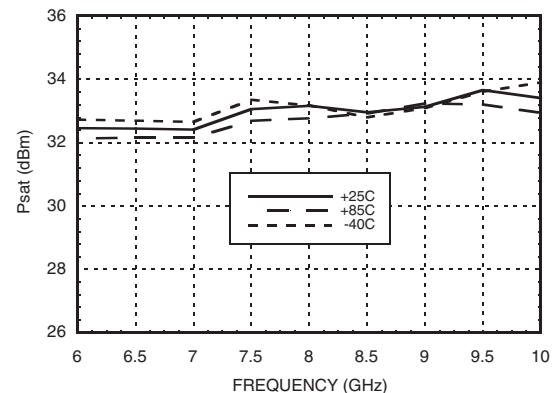
**Output Return Loss vs. Temperature**



**P<sub>1dB</sub> vs. Temperature**



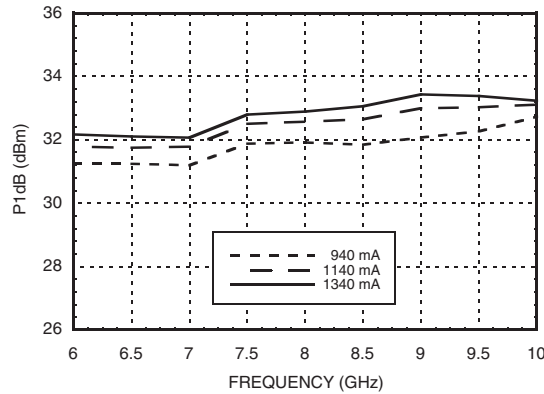
**Psat vs. Temperature**



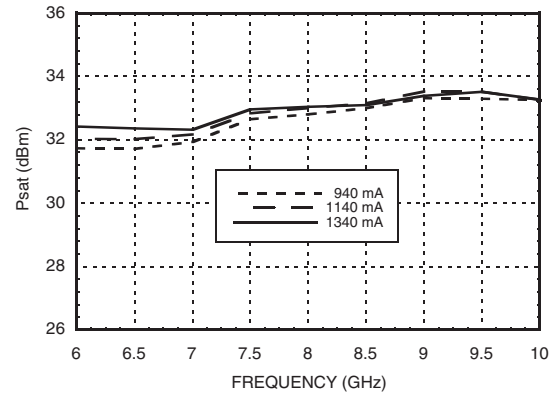
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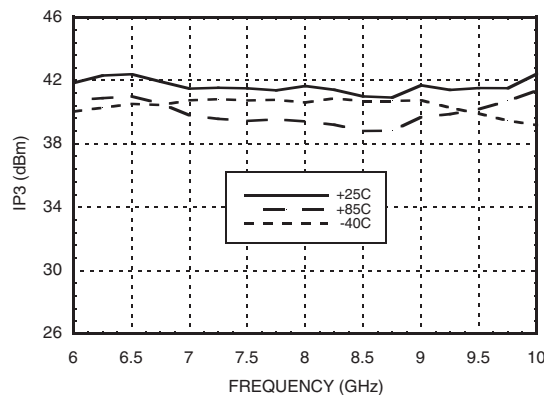
**P1dB vs. Current**



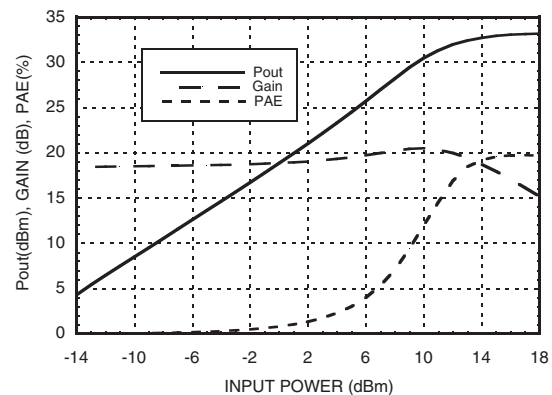
**Psat vs. Current**



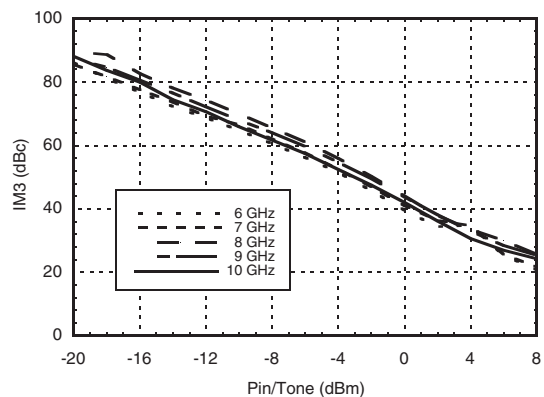
**Output IP3 vs. Temperature**  
7V @ 940 mA, Pin/Tone = -15 dBm



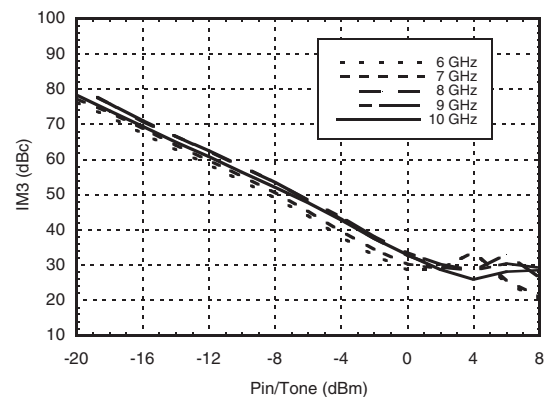
**Power Compression @ 8 GHz,**  
7V @ 1340 mA



**Output IM3, 7V @ 940 mA**



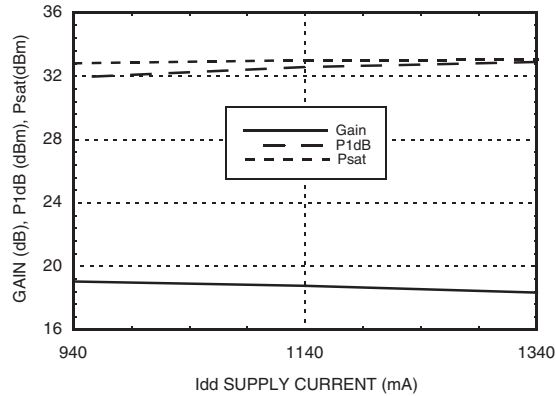
**Output IM3, 7V @ 1340 mA**



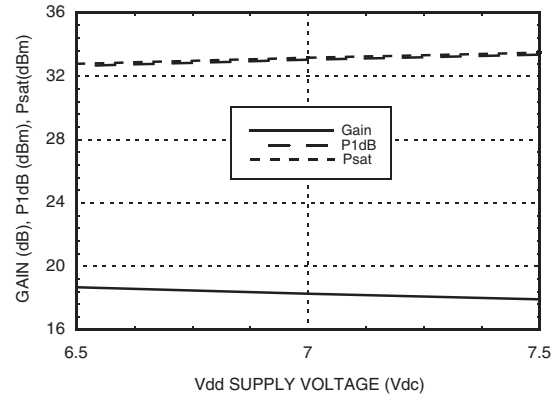
## HMC591LP5 / 591LP5E

### GaAs PHEMT MMIC 2 WATT POWER AMPLIFIER, 6.0 - 9.5 GHz

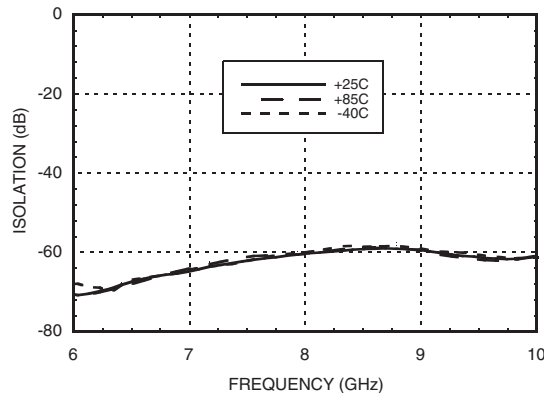
**Gain & Power vs. Supply Current @ 8 GHz**



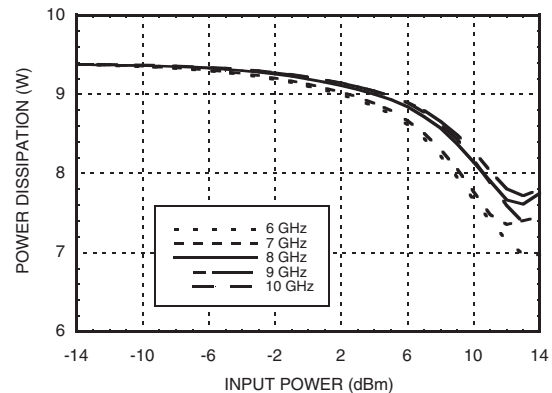
**Gain & Power vs. Supply Voltage @ 8 GHz**



**Reverse Isolation  
vs. Temperature, 7V @ 1340 mA**



**Power Dissipation**



#### Absolute Maximum Ratings

|                                                                 |                |
|-----------------------------------------------------------------|----------------|
| Drain Bias Voltage (Vdd)                                        | +8 Vdc         |
| Gate Bias Voltage (Vgg)                                         | -2.0 to 0 Vdc  |
| RF Input Power (RFIN)(Vdd = +7.0 Vdc)                           | +15 dBm        |
| Channel Temperature                                             | 175 °C         |
| Continuous Pdiss (T= 75 °C)<br>(derate 104.3 mW/°C above 75 °C) | 10.43 W        |
| Thermal Resistance<br>(channel to package bottom)               | 9.59 °C/W      |
| Storage Temperature                                             | -65 to +150 °C |
| Operating Temperature                                           | -40 to +85 °C  |

#### Typical Supply Current vs. Vdd

| Vdd (V) | Idd (mA) |
|---------|----------|
| +6.5    | 1350     |
| +7.0    | 1340     |
| +7.5    | 1330     |

Note: Amplifier will operate over full voltage ranges shown above Vgg adjusted to achieve Idd = 1340 mA at +7.0V

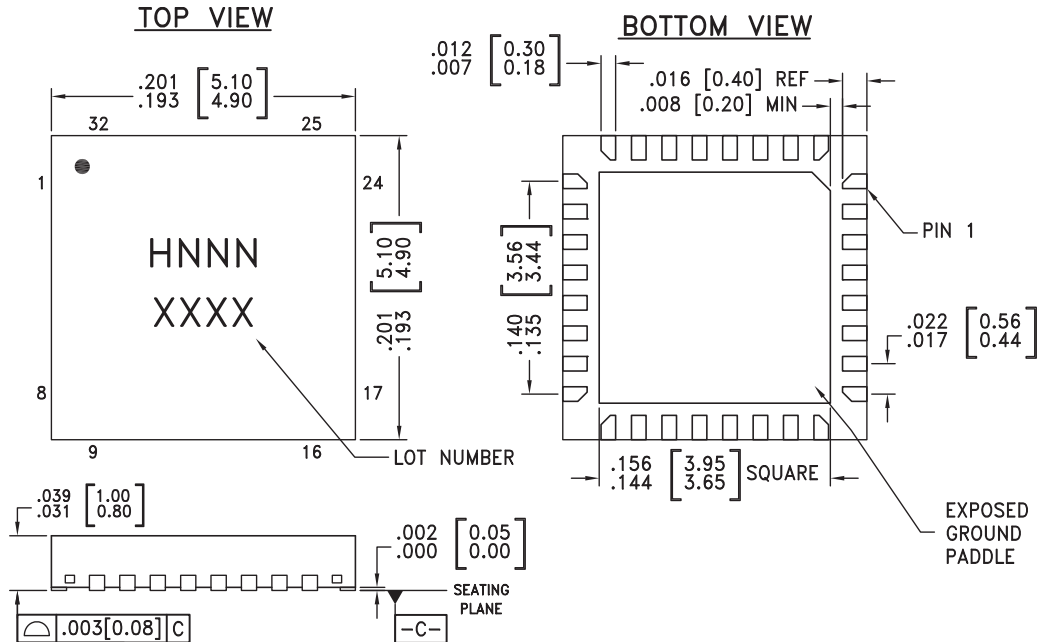


ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS

# HMC591LP5 / 591LP5E

**GaAs PHEMT MMIC 2 WATT  
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## Outline Drawing



### NOTES:

1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE
4. PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM.  
PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
5. PACKAGE WARP SHALL NOT EXCEED 0.05mm.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
7. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.

## Package Information

| Part Number | Package Body Material                              | Lead Finish   | MSL Rating          | Package Marking <sup>[3]</sup> |
|-------------|----------------------------------------------------|---------------|---------------------|--------------------------------|
| HMC591LP5   | Low Stress Injection Molded Plastic                | Sn/Pb Solder  | MSL1 <sup>[1]</sup> | H591<br>XXXX                   |
| HMC591LP5E  | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 <sup>[2]</sup> | H591<br>XXXX                   |

[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX



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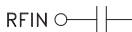
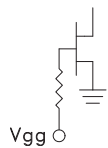
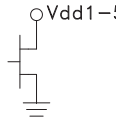
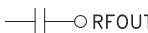
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## HMC591LP5 / 591LP5E

**GaAs PHEMT MMIC 2 WATT  
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### Pad Descriptions

| Pad Number                                                              | Function | Description                                                                                                                                                                                         | Interface Schematic                                                                   |
|-------------------------------------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1, 2, 6 - 8,<br>10 - 12, 14, 15,<br>17 - 19, 23, 24,<br>26, 27, 29 - 31 | N/C      | Not connected.                                                                                                                                                                                      |                                                                                       |
| 3, 5, 20, 22                                                            | GND      | Package bottom has an exposed metal paddle that must be connected to RF/DC ground.                                                                                                                  |    |
| 4                                                                       | RFIN     | This pad is AC coupled and matched to 50 Ohms.                                                                                                                                                      |    |
| 9                                                                       | Vgg      | Gate control for amplifier. Adjust to achieve Idd of 1340 mA. Please follow "MMIC Amplifier Biasing Procedure" Application Note. External bypass capacitors of 100 pF and 2.2 $\mu$ F are required. |    |
| 13, 16, 25, 28, 32                                                      | Vdd 1-5  | Power Supply Voltage for the amplifier. External bypass capacitors of 100 pF and 2.2 $\mu$ F are required.                                                                                          |    |
| 21                                                                      | RFOUT    | This pad is AC coupled and matched to 50 Ohms.                                                                                                                                                      |  |

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LINEAR & POWER AMPLIFIERS - SMT



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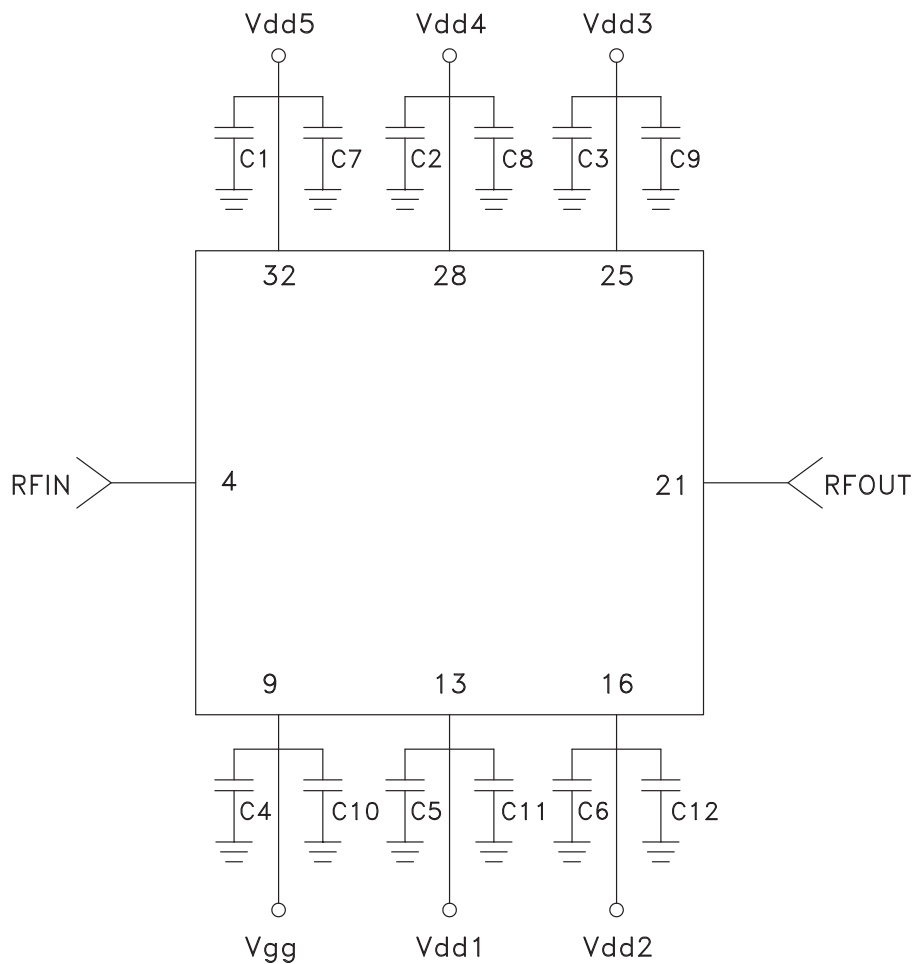


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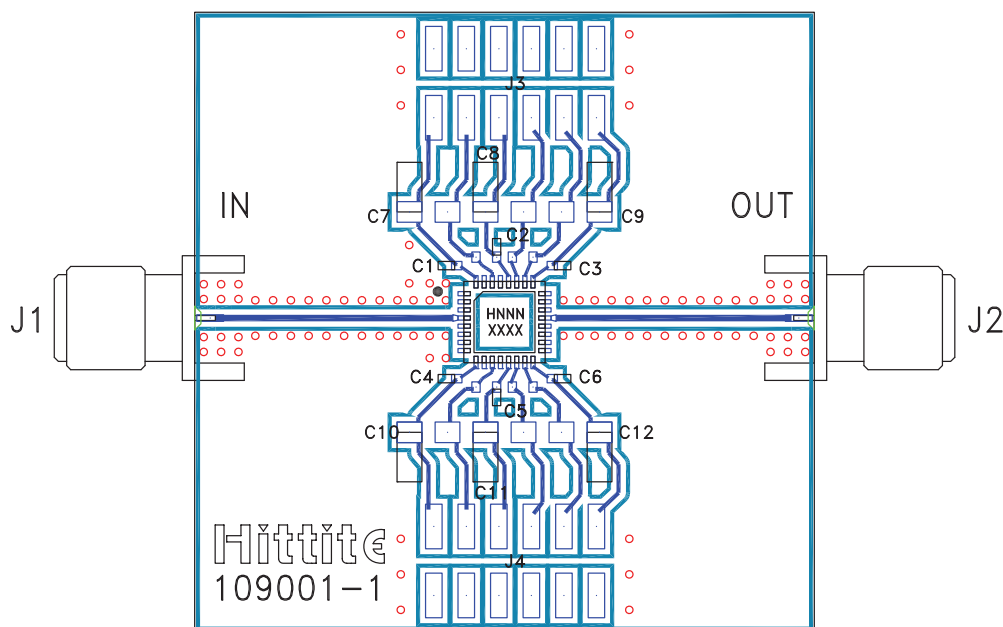
**GaAs PHEMT MMIC 2 WATT  
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### Application Circuit

| Component | Value |
|-----------|-------|
| C1 - C6   | 100pF |
| C7 - C12  | 2.2μF |



### Evaluation PCB



### List of Materials for Evaluation PCB 108190 <sup>[1]</sup>

| Item               | Description                     |
|--------------------|---------------------------------|
| J1 - J2            | PCB Mount SMA Connector         |
| J3 - J4            | DC Pin                          |
| C1 - C6            | 100pF Capacitor, 0402 Pkg.      |
| C7 - C12           | 2.2 $\mu$ F Capacitor, 1206 Pkg |
| U1                 | HMC591LP5 / HMC591LP5E          |
| PCB <sup>[2]</sup> | 109001 Evaluation PCB           |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

The circuit board used in the final application should use RF circuit design techniques. Signal lines should have 50 ohm impedance while the package ground leads and package bottom 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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