



GaAs pHEMT MMIC 1 WATT POWER AMPLIFIER, 6.0 - 9.5 GHz

Typical Applications

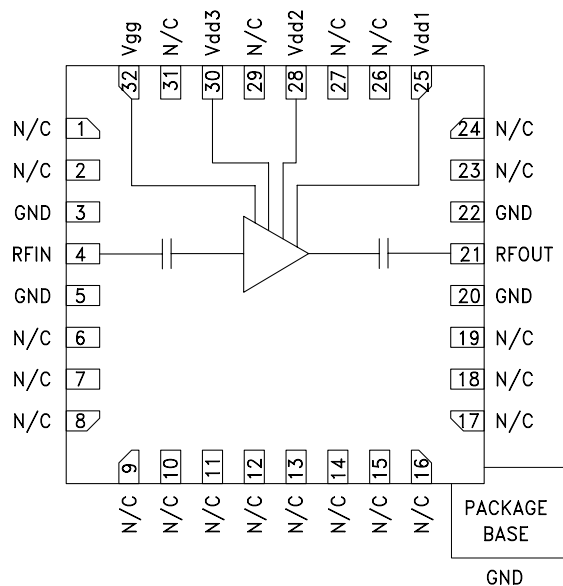
The HMC590LP5E is ideal for use as a power amplifier for:

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

Features

- Saturated Output Power: +31.5 dBm @ 23% PAE
- Output IP3: +40 dBm
- Gain: 21 dB
- DC Supply: +7V @ 820 mA
- 50 Ohm Matched Input/Output
- QFN Leadless SMT Packages, 25 mm²

Functional Diagram



General Description

The HMC590LP5E are high dynamic range GaAs pHEMT MMIC 1 Watt Power Amplifiers which operate from 6 to 9.5 GHz. The amplifier provides 21 dB of gain, +31 dBm of saturated power, and 23% 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, I_{dd} should be set for 520 mA, to yield +40 dBm OIP3. For applications which require optimum output P1dB, I_{dd} should be set for 820 mA, to yield +30 dBm Output P1dB.

Electrical Specifications, $T_A = +25^\circ\text{C}$, $V_{dd} = +7\text{V}$, $I_{dd} = 820\text{mA}$ ^[1]

| Parameter | Min. | Typ. | Max. | Min. | Typ. | Max. | Units |
|---|-------|------|---------|------|------|------|-------|
| Frequency Range | 6 - 8 | | 6 - 9.5 | | | | GHz |
| Gain | 18 | 21 | | 18 | 21 | | dB |
| Gain Variation Over Temperature | | 0.05 | | | 0.05 | | dB/°C |
| Input Return Loss | | 15 | | | 12 | | dB |
| Output Return Loss | | 11 | | | 10 | | dB |
| Output Power for 1 dB Compression (P1dB) | 27 | 30 | | 27.5 | 30.5 | | dBm |
| Saturated Output Power (Psat) | | 30.5 | | | 31 | | dBm |
| Output Third Order Intercept (IP3) ^[2] | | 40 | | | 40 | | dBm |
| Supply Current (I _{dd}) | | 820 | | | 820 | | mA |

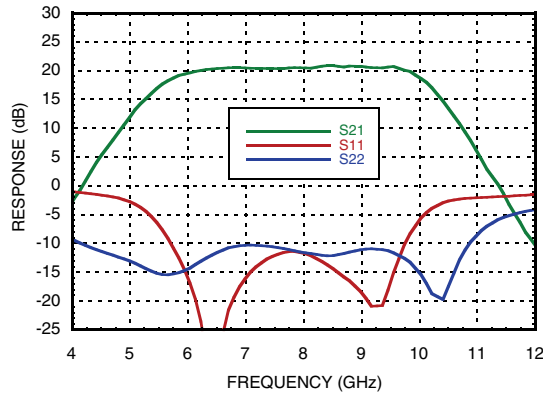
[1] Adjust V_{gg} between -2 to 0V to achieve I_{dd}= 820 mA typical.

[2] Measurement taken at 7V @ 520mA, Pin/Tone = -15 dBm

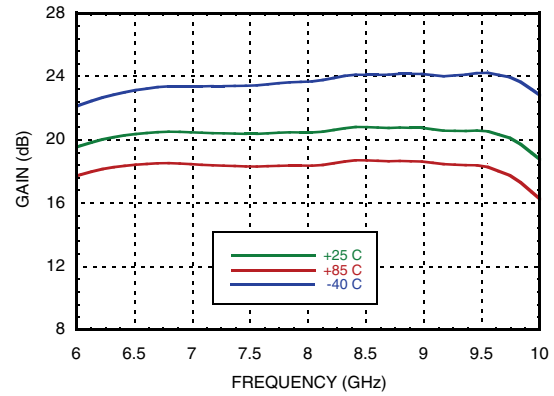


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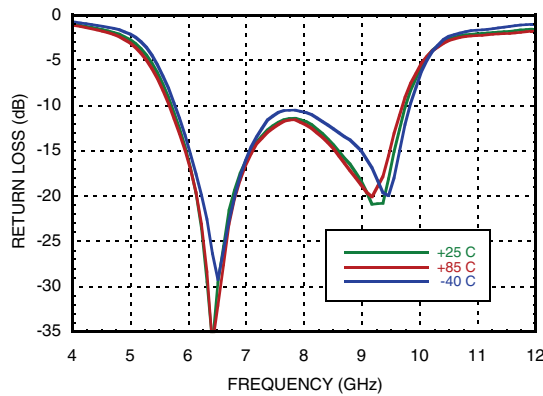
Broadband Gain & Return Loss



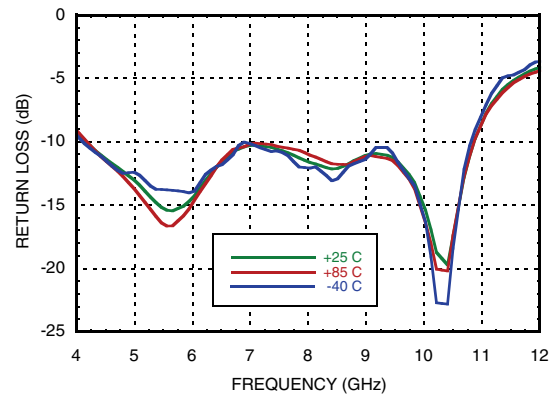
Gain vs. Temperature



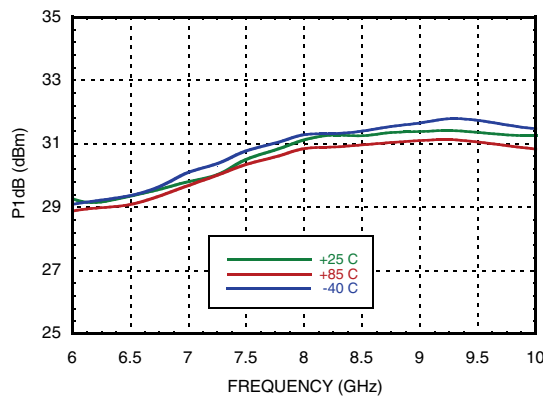
Input Return Loss vs. Temperature



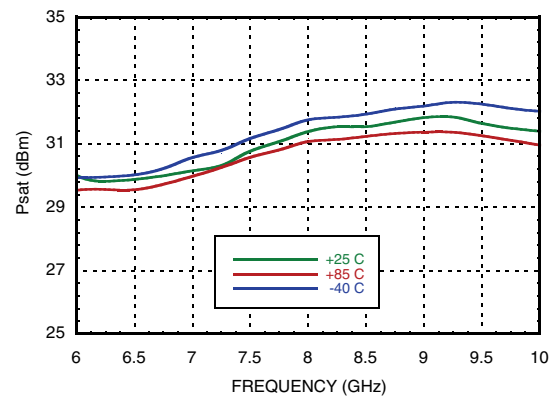
Output Return Loss vs. Temperature



P1dB vs. Temperature



Psat vs. Temperature

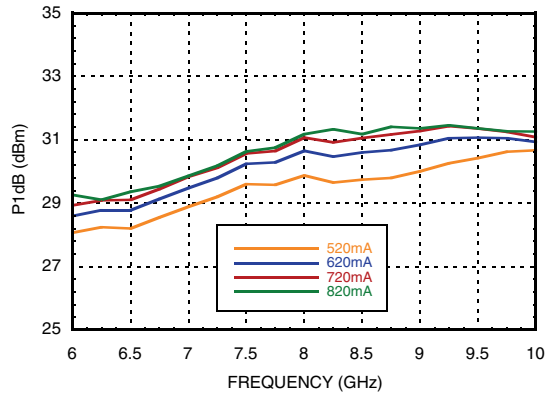




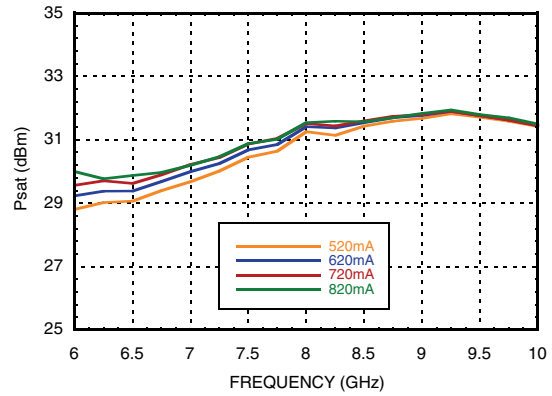
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LINEAR & POWER AMPLIFIERS - SMT

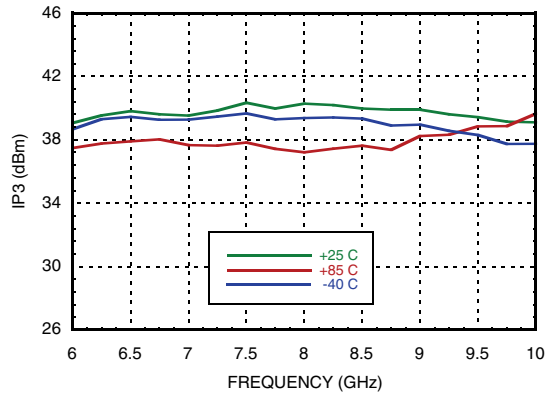
P1dB vs. Current



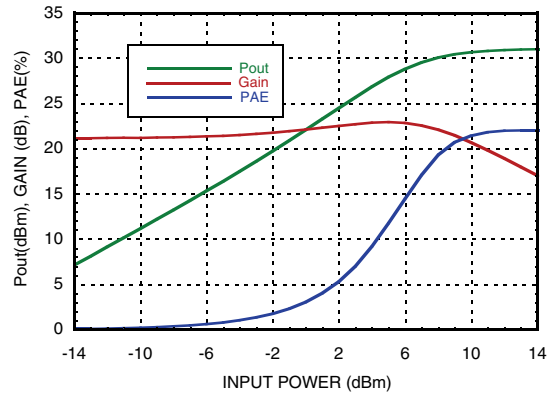
Psat vs. Current



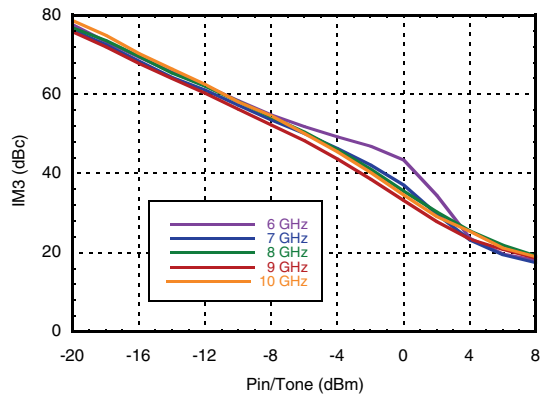
Output IP3 vs. Temperature
7V @ 520 mA, Pin/Tone = -15 dBm



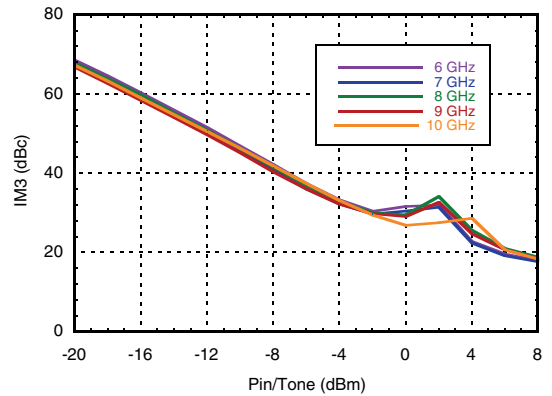
Power Compression @ 8 GHz,
7V @ 820 mA



Output IM3, 7V @ 520 mA



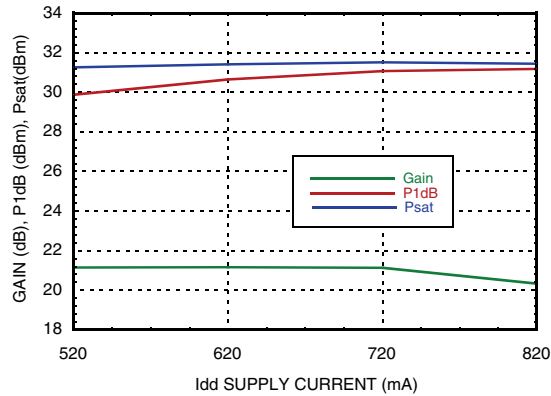
Output IM3, 7V @ 820 mA



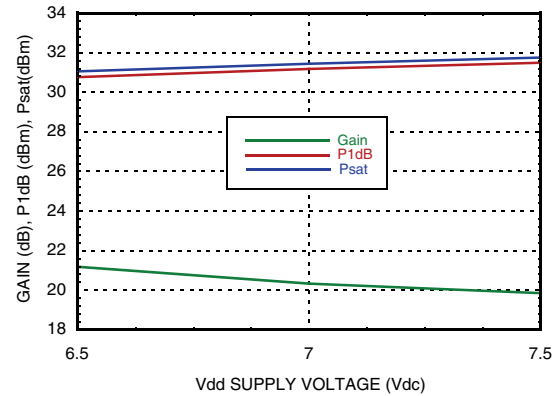


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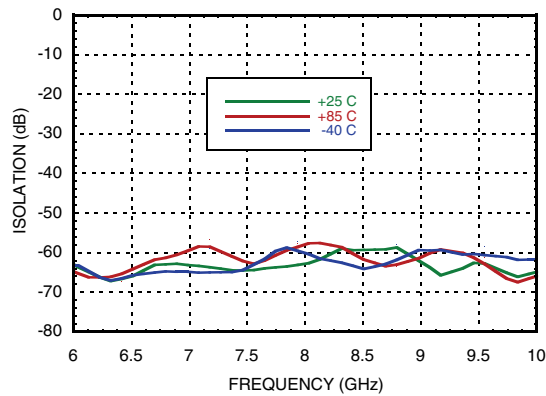
Gain & Power vs. Supply Current @ 8 GHz



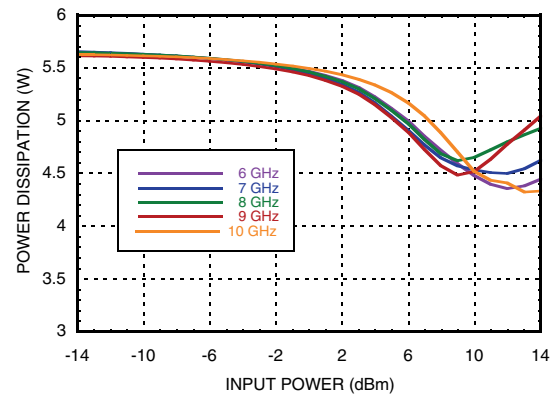
Gain & Power vs. Supply Voltage @ 8 GHz



Reverse Isolation vs. Temperature, 7V @ 820 mA



Power Dissipation



Absolute Maximum Ratings

| | |
|--|-----------------------|
| Drain Bias Voltage (V _{dd}) | +8 Vdc |
| Gate Bias Voltage (V _{gg}) | -2.0 to 0 Vdc |
| RF Input Power (RFIN)(V _{dd} = +7.0 Vdc) | +12 dBm |
| Channel Temperature | 175 °C |
| Continuous Pdiss (T= 75 °C) (derate 59.8 mW/°C above 75 °C) | 5.98 W |
| Thermal Resistance (channel to package bottom) | 16.72 °C/W |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -55 to +85 °C |
| ESD Sensitivity (HBM) | Class 0B. Passed 200V |

Typical Supply Current vs. V_{dd}

| V _{dd} (V) | I _{dd} (mA) |
|---------------------|----------------------|
| +6.5 | 824 |
| +7.0 | 820 |
| +7.5 | 815 |

Note: Amplifier will operate over full voltage ranges shown above V_{gg} adjusted to achieve I_{dd} = 820 mA at +7.0V

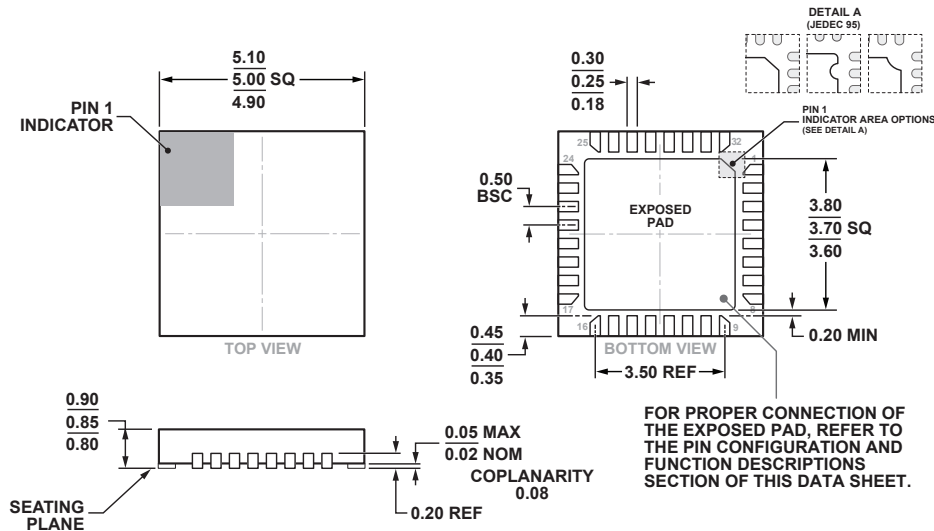


ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS



**GaAs pHEMT MMIC 1 WATT
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Outline Drawing



COMPLIANT TO JEDEC STANDARDS MO-220-VHHD-4.

32-Lead Lead Frame Chip Scale Package [LFCSP]
5 mm × 5 mm and 0.90 mm Package Height
(HCP-32-3)
Dimensions shown in millimeters


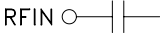
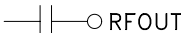
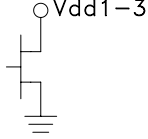
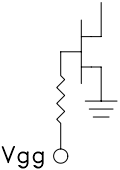
Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[2] |
|--------------|--|---------------|---------------------|--------------------------------|
| HMC590LP5E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL3 ^[1] | H590 XXXX |
| HMC590LP5ETR | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL3 ^[1] | H590 XXXX |

[1] Max peak reflow temperature of 260 °C

[2] 4-Digit lot number XXXX

**GaAs pHEMT MMIC 1 WATT
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Pin Descriptions

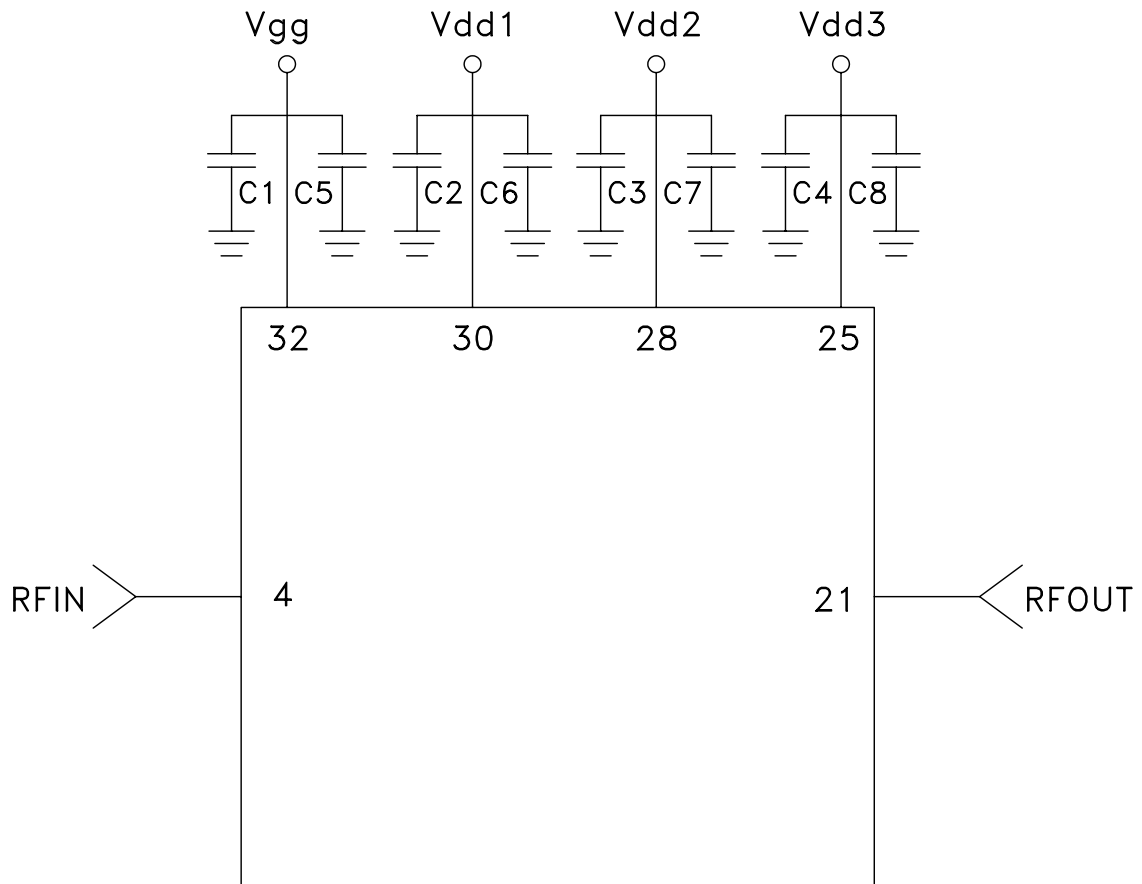
| Pin Number | Function | Description | Interface Schematic |
|--|----------|---|--|
| 1, 2, 6 - 19, 23, 24, 26, 27, 29, 31 | N/C | Not connected. | |
| 3, 5, 20, 22 | GND | These pins and package bottom must be connected to RF/DC ground. |  |
| 4 | RFIN | This pad is AC coupled and matched to 50 Ohms. |  |
| 21 | RFOUT | This pad is AC coupled and matched to 50 Ohms. |  |
| 25, 28, 30 | Vdd 1-3 | Power Supply Voltage for the amplifier. External bypass capacitors of 100 pF and 2.2 μF are required. |  |
| 32 | Vgg | Gate control for amplifier. Adjust to achieve I _{dd} of 820 mA. Please follow "MMIC Amplifier Biasing Procedure" Application Note. External bypass capacitors of 100 pF and 2.2 μF are required. |  |



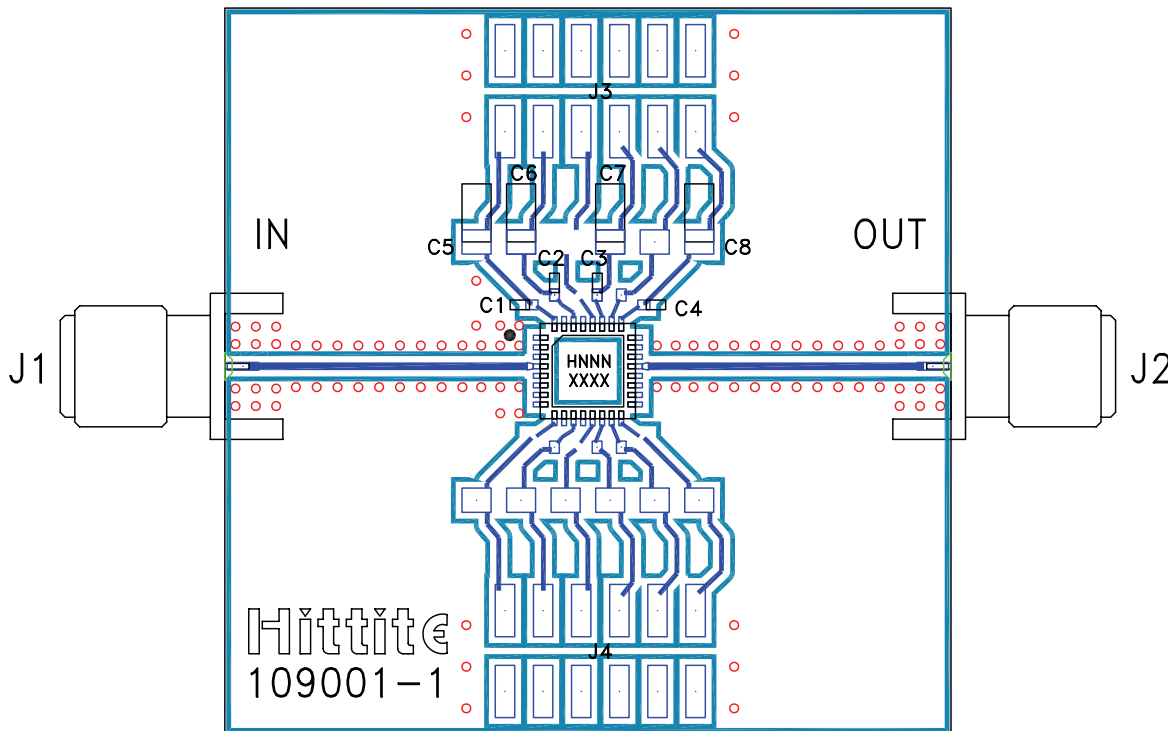
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Application Circuit

| Component | Value |
|-----------|-------|
| C1 - C4 | 100pF |
| C5 - C8 | 2.2μF |



Evaluation PCB



List of Materials for Evaluation PCB 115927-HMC590LP5 [1]

| Item | Description |
|---------|----------------------------|
| J1 - J2 | PCB Mount SMA Connector |
| J3 | DC Pin |
| C1 - C4 | 100 pF Capacitor, 0402 Pkg |
| C5 - C8 | 2.2 μF Capacitor, 1206 Pkg |
| U1 | HMC590LP5E |
| PCB [2] | 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 Analog Devices, Inc. upon request.