



GaAs InGaP HBT MMIC

POWER AMPLIFIER, 4.9 - 5.9 GHz

Typical Applications

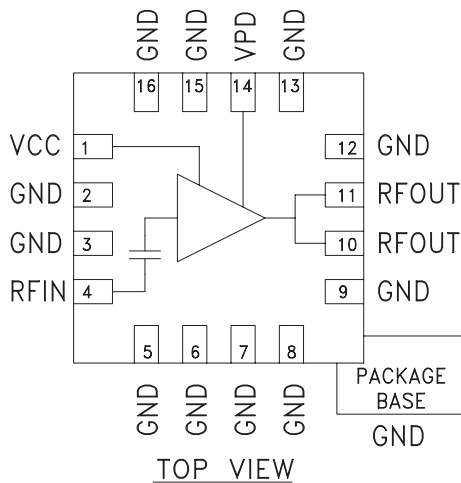
This amplifier is ideal for use as a power amplifier for 4.9 - 5.9 GHz applications:

- 802.11a WLAN
- HiperLAN WLAN
- Access Points
- UNII & ISM Radios

Features

- Gain: 20 dB
- 34% PAE @ Psat = +26 dBm
- 3.7% EVM @ Pout = +15 dBm with 54 Mbps OFDM Signal
- Supply Voltage: +3V
- Power Down Capability
- Low External Part Count

Functional Diagram



General Description

The HMC415LP3 & HMC415LP3E are high efficiency GaAs InGaP Heterojunction Bipolar Transistor (HBT) MMIC Power amplifiers which operate between 4.9 and 5.9 GHz. The amplifier is packaged in a low cost, leadless surface mount package with an exposed base for improved RF and thermal performance. With a minimum of external components, the amplifier provides 20 dB of gain, +26 dBm of saturated power, and 34% PAE from a +3V supply voltage. Vpd can be used for full power down or RF output power/current control. For +15 dBm OFDM output power (64 QAM, 54 Mbps), the HMC415LP3 & HMC415LP3E achieve an error vector magnitude (EVM) of 3.7% meeting 802.11a linearity requirements.

Electrical Specifications, $T_A = +25^\circ C$, $V_s = 3V$, $V_{pd} = 3V$

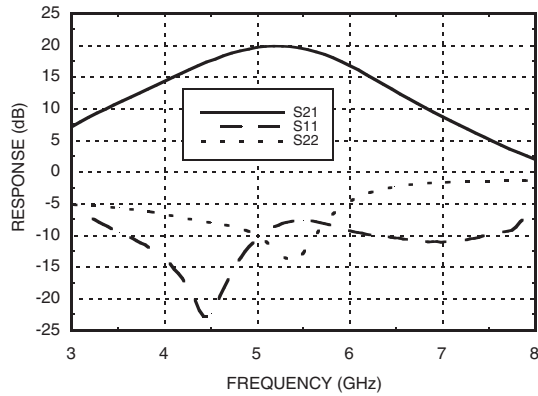
| Parameter | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | Units |
|---|------------------------------|------|----------------|-----------|----------------|------|-----------|----------------|------|---------|
| Frequency Range | 4.9 - 5.1 | | | 5.1 - 5.4 | | | 5.4 - 5.9 | | | GHz |
| Gain | 18 | 20 | | 18.5 | 20.5 | | 16 | 19 | | dB |
| Gain Variation Over Temperature | | 0.04 | 0.05 | | 0.04 | 0.05 | | 0.04 | 0.05 | dB / °C |
| Input Return Loss | | 10 | | | 9 | | | 8 | | dB |
| Output Return Loss | | 10 | | | 12 | | | 8 | | dB |
| Output Power for 1dB Compression (P1dB) | Icq = 285 mA Icq = 200 mA | 20 | 22.5 22.0 | 20.5 | 23.0 22.5 | | 18 | 21.5 21.0 | | dBm |
| Saturated Output Power (Psat) | | 25.5 | | | 26 | | | 24 | | dBm |
| Output Third Order Intercept (IP3) | | 28 | 31 | 29 | 32 | | 27 | 30 | | dBm |
| Error Vector Magnitude (54 Mbps OFDM Signal @ +15 dBm Pout) | Icq = 200 mA | | | | 3.7 | | | | | % |
| Noise Figure | | 6 | | | 6 | | | 6 | | dB |
| Supply Current (Icq) | Vpd = 0V/3V | | 0.002 / 285 | | 0.002 / 285 | | | 0.002 / 285 | | mA |
| Control Current (Ipd) | Vpd = 3V | | 7 | | 7 | | | 7 | | mA |
| Switching Speed | tOn, tOff | | 45 | | 45 | | | 45 | | ns |

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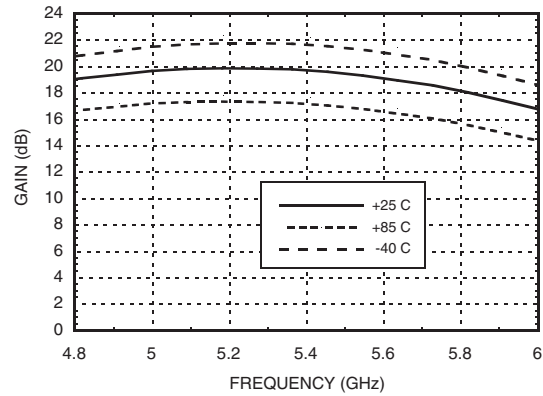
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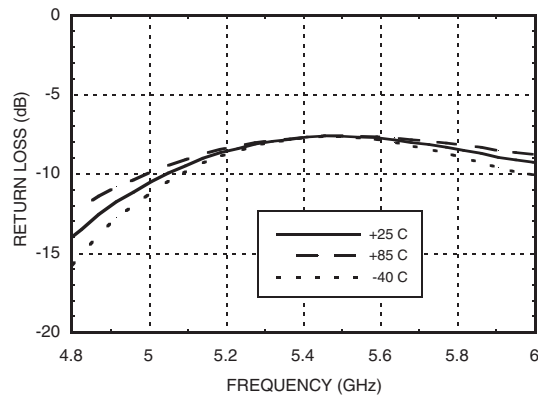
Broadband Gain & Return Loss



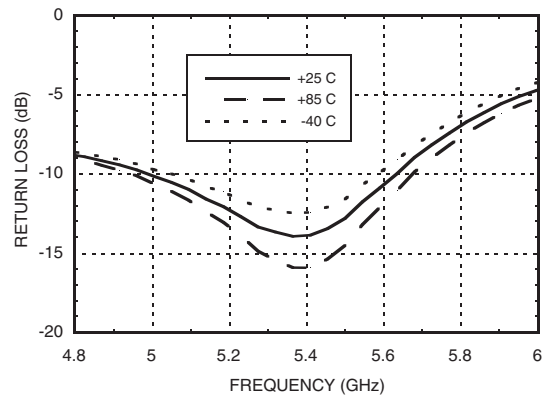
Gain vs. Temperature



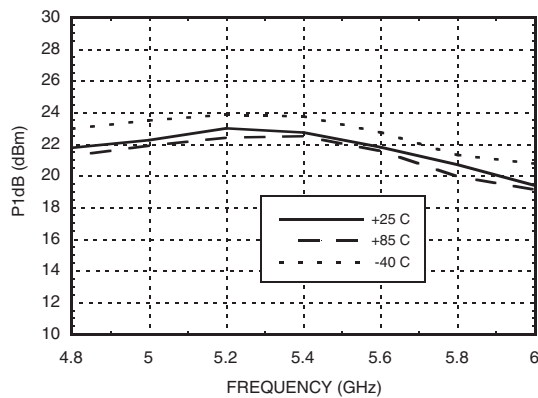
Input Return Loss vs. Temperature



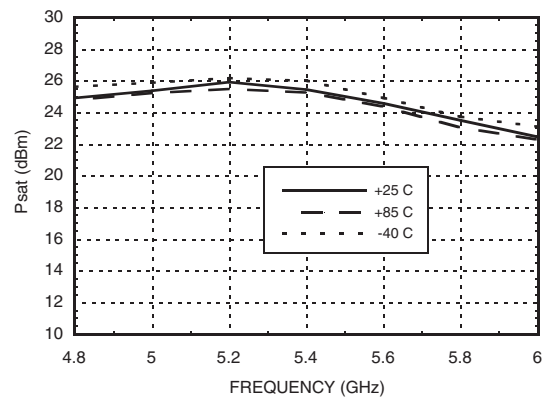
Output Return Loss vs. Temperature



P1dB vs. Temperature



Psat vs. Temperature



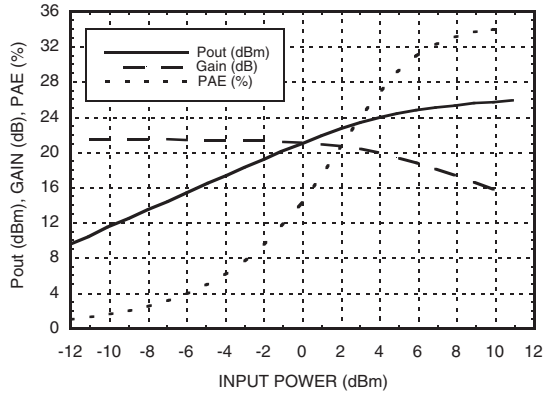
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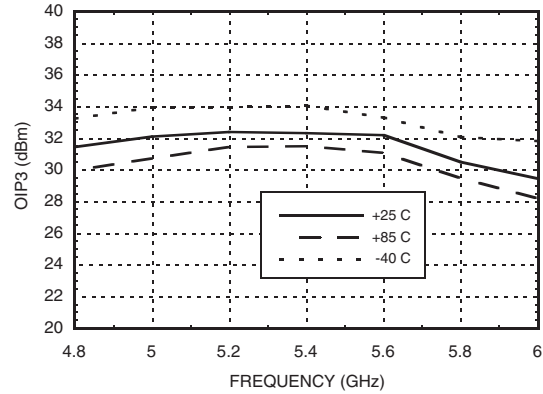


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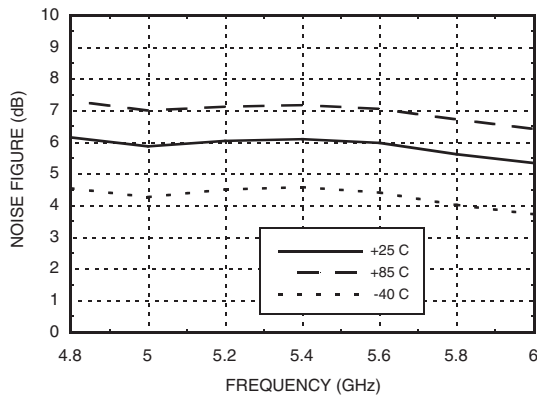
Power Compression @ 5.2 GHz



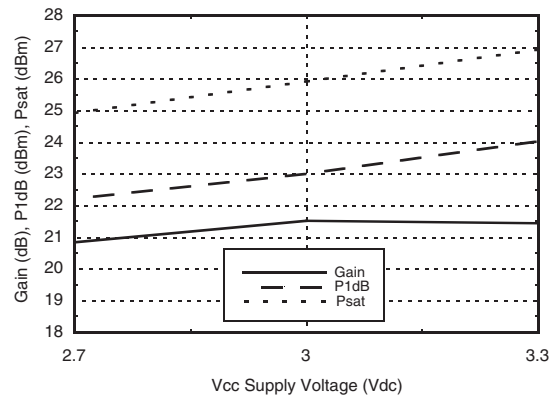
Output IP3 vs. Temperature



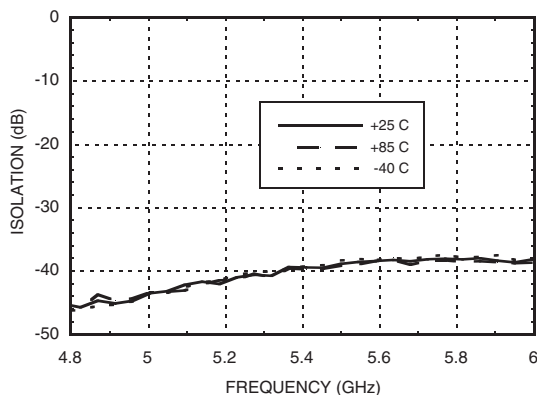
Noise Figure vs. Temperature



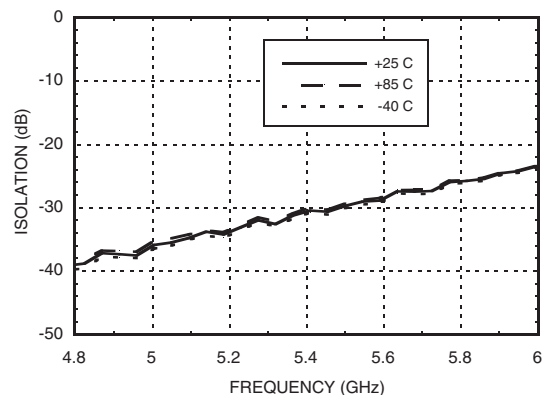
Gain & Power vs. Supply Voltage



Reverse Isolation vs. Temperature



Power Down Isolation vs. Temperature



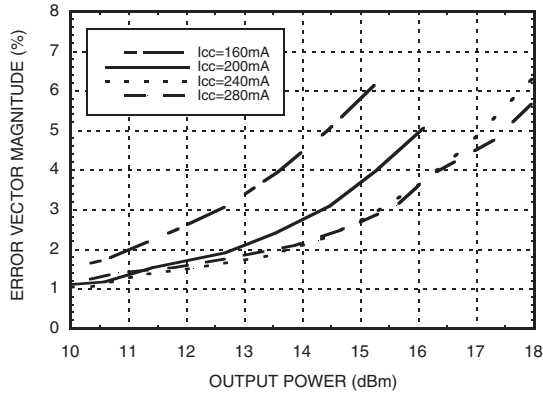
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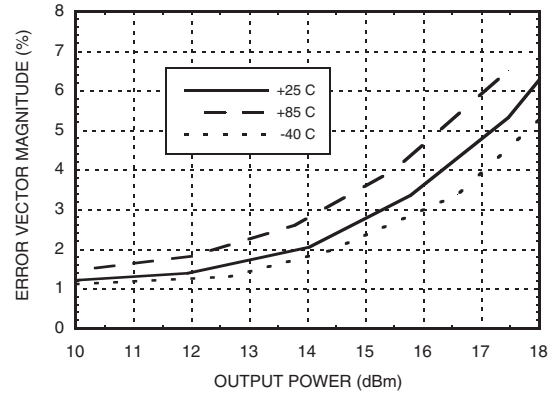


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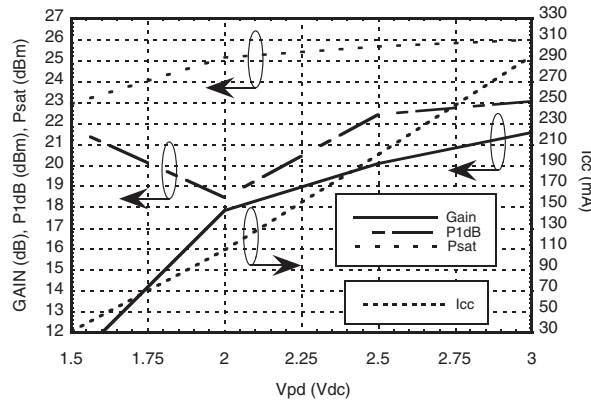
**EVM vs. Supply Current,
F = 5.2 GHz**



**EVM vs. Temperature,
Icc = 240 mA, F = 5.2 GHz**



**Gain, Power & Quiescent
Supply Current vs. Vpd @ 5.2 GHz**



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LINEAR & POWER AMPLIFIERS - SMT

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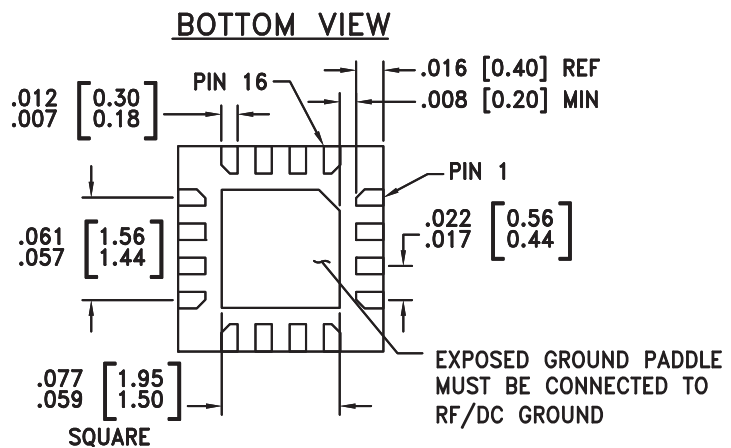
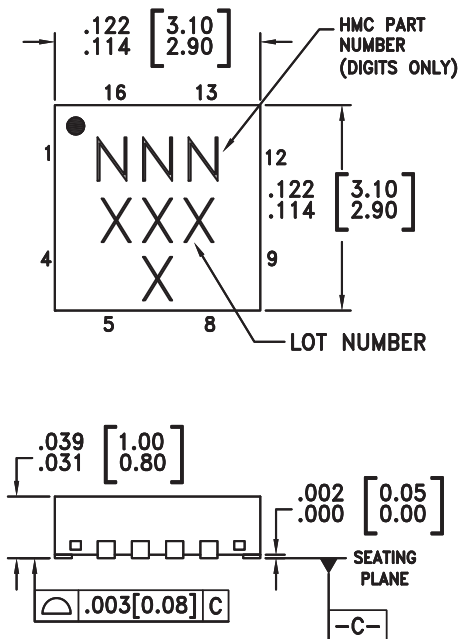
Absolute Maximum Ratings

| | |
|---|----------------|
| Collector Bias Voltage (Vcc) | +5Vdc |
| Control Voltage (Vpd) | +3.5 Vdc |
| RF Input Power (RFIN)(Vs = Vpd = +3.0 Vdc) | +13 dBm |
| Junction Temperature | 150 °C |
| Continuous P _{diss} (T = 85 °C) (derate 17 mW/°C above 85 °C) | 1.105 W |
| Thermal Resistance (junction to ground paddle) | 59 °C/W |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -40 to +85 °C |



**ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS**

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 HITITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.

Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[3] |
|-------------|--|---------------|---------------------|--------------------------------|
| HMC415LP3 | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 ^[1] | 415 XXXX |
| HMC415LP3E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 ^[2] | 415 XXXX |

[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

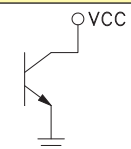

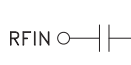
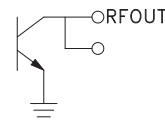
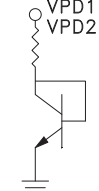
[3] 4-Digit lot number XXXX

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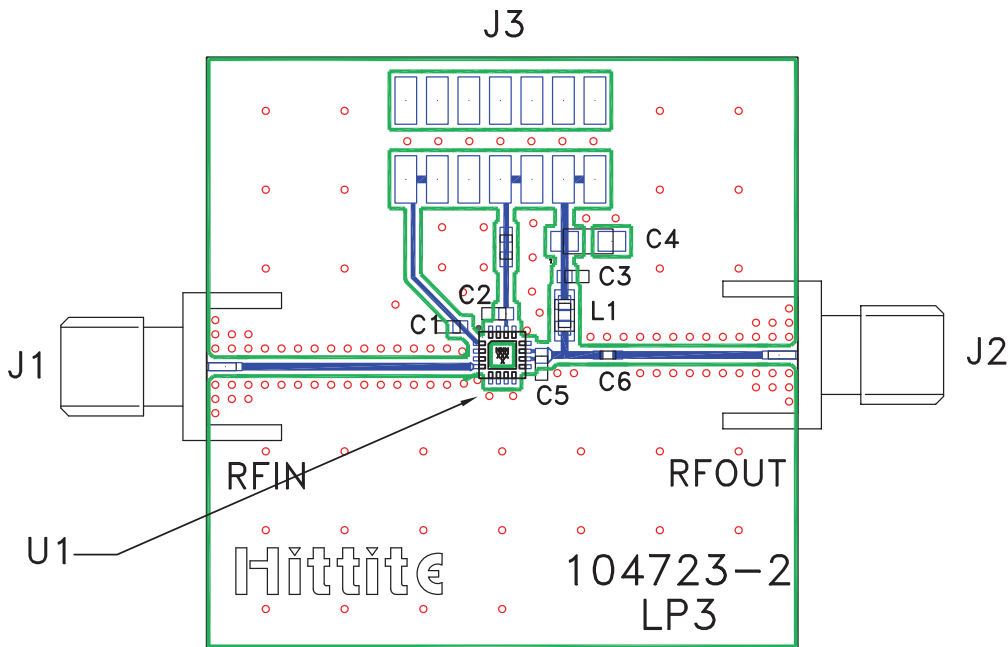


Pin Descriptions

| Pin Number | Function | Description | Interface Schematic |
|-------------------------------------|----------|---|--|
| 1 | Vcc | Power supply voltage for the first amplifier stage. An external bypass capacitor of 330 pF is required as shown in the application schematic. |  |
| 2, 3, 5, 6, 7, 8, 9, 12, 13, 15, 16 | 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. |  |
| 4 | RFIN | This pin is AC coupled and matched to 50 Ohms from 5.0 to 6.0 GHz. |  |
| 10, 11 | RFOUT | RF output and DC bias for the output stage. |  |
| 14 | Vpd | Power control pin. For maximum power, this pin should be connected to 3.0V. A higher voltage is not recommended. For lower idle current, this voltage can be reduced. |  |



Evaluation PCB



List of Materials for Evaluation PCB 105173 [1]

| Item | Description |
|---------|----------------------------------|
| J1 - J2 | PCB Mount SMA RF Connector |
| J3 | 2 mm DC Header |
| C1 - C3 | 330 pF Capacitor, 0603 Pkg. |
| C4 | 2.2 μ F Capacitor, Tantalum |
| C5 | 0.5 pF Capacitor, 0603 Pkg. |
| C6 | 7.0 pF Capacitor, 0402 Pkg. |
| L1 | 3.0 nH Inductor, 0805 Pkg. |
| U1 | HMC415LP3 / HMC415LP3E Amplifier |
| PCB [2] | 104723 Eval Board |

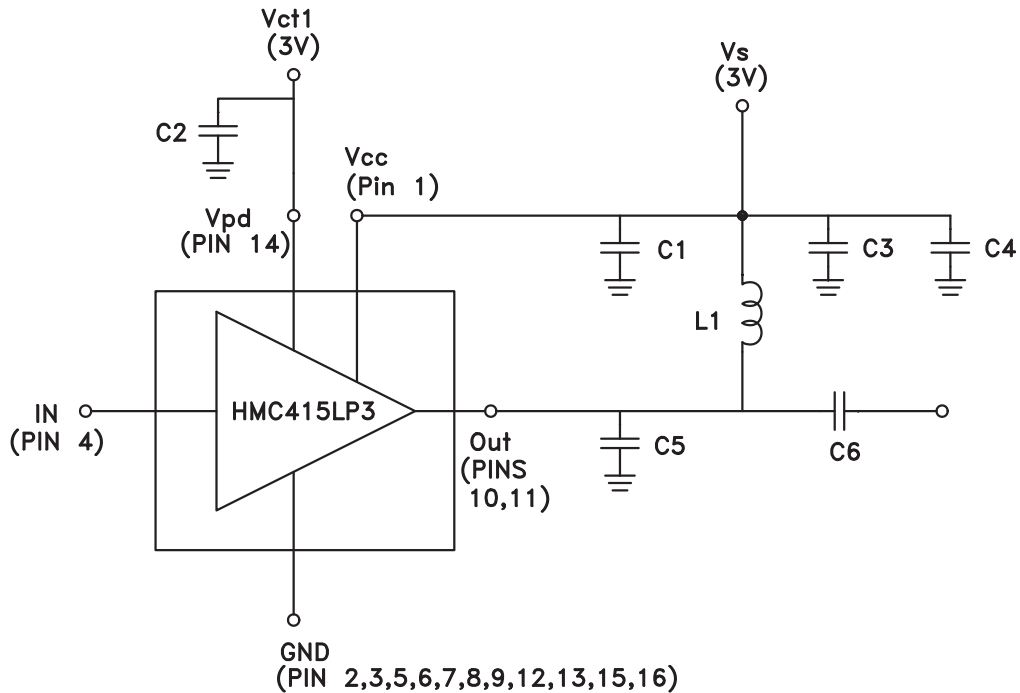
[1] Reference this number when ordering complete evaluation PCB

[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 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.



Application Circuit



| Recommended Component Values | |
|------------------------------|-------------|
| L1 | 3.0 nH |
| C1, C2, C3 | 330 pF |
| C4 | 2.2 μ F |
| C5 | 0.5 pF |
| C6 | 7.0 pF |

Note 1: C1 should be located < 0.1" (2.54mm) from Pin 1 (Vcc)

Note 2: C3 should be located < 0.1" (2.54mm) from L1.

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