

## GaAs PHEMT MMIC LOW NOISE AMPLIFIER, 2.1 - 2.9 GHz



### Typical Applications

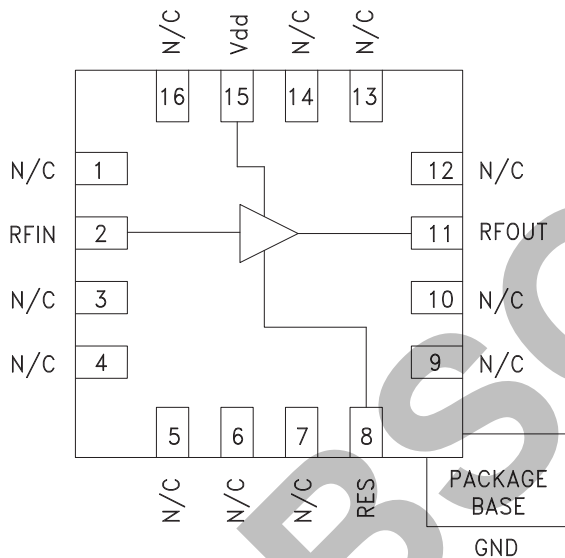
The HMC715LP3(E) is ideal for:

- Cellular/3G and LTE/WiMAX/4G
- BTS & Infrastructure
- Repeaters and Femtocells
- Public Safety Radio
- Access Points

### Features

- Noise Figure: 0.9 dB
- Gain: 19 dB
- Output IP3: +33 dBm
- Single Supply: +3V to +5V
- 16 Lead 3x3mm QFN Package: 9 mm<sup>2</sup>

### Functional Diagram



### General Description

The HMC715LP3(E) is a GaAs PHEMT MMIC Low Noise Amplifier that is ideal for Cellular/3G and LTE/WiMAX/4G basestation front-end receivers operating between 2.1 and 2.9 GHz. The amplifier has been optimized to provide 0.9 dB noise figure, 19 dB gain and +33 dBm output IP3 from a single supply of +5V. Input and output return losses are excellent and the LNA requires minimal external matching and bias decoupling components. The HMC715LP3(E) can be biased with +3V to +5V and features an externally adjustable supply current which allows the designer to tailor the linearity performance of the LNA for each application.

### Electrical Specifications

$T_A = +25^\circ\text{C}$ ,  $R_{bias} = 2k\ \text{Ohms}$  for  $V_{dd} = +5V$ ,  $R_{bias} = 47k\ \text{Ohms}$  for  $V_{dd} = +3V$  [1]

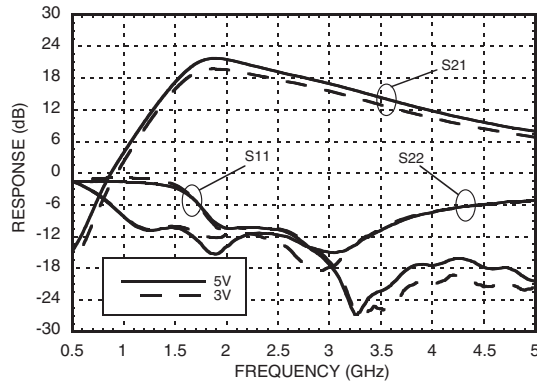
| Parameter                                | Vdd = +3V |      |      | Vdd = +5V |      |      | Vdd = +3V |      |      | Vdd = +5V |      |      | Units |
|--|-----------|------|------|-----------|------|------|-----------|------|------|-----------|------|------|-------|
|  | Min.      | Typ. | Max. | Min.      | Typ. | Max. | Min.      | Typ. | Max. | Min.      | Typ. | Max. |       |
| Frequency Range                          | 2.1 - 2.9 |      |      | 2.3 - 2.7 |      |      | 2.1 - 2.9 |      |      | 2.3 - 2.7 |      |      | MHz   |
| Gain                                     | 14.5      | 18   |      | 15        | 18   |      | 15.5      | 19   |      | 16.5      | 19   |      | dB    |
| Gain Variation Over Temperature          |           | 0.01 |      |           | 0.01 |      |           | 0.01 |      |           | 0.01 |      | dB/°C |
| Noise Figure                             |           | 0.9  | 1.2  |           | 0.9  | 1.2  |           | 0.9  | 1.2  |           | 0.9  | 1.2  | dB    |
| Input Return Loss                        |           | 11.5 |      |           | 11   |      |           | 11.5 |      |           | 11   |      | dB    |
| Output Return Loss                       |           | 14   |      |           | 13.5 |      |           | 12.5 |      |           | 12   |      | dB    |
| Output Power for 1 dB Compression (P1dB) | 10.5      | 14.5 |      | 12.5      | 15   |      | 15        | 19   |      | 16.5      | 19.5 |      | dBm   |
| Saturated Output Power (Psat)            |           | 16   |      |           | 16.5 |      |           | 20   |      |           | 20.5 |      | dBm   |
| Output Third Order Intercept (IP3)       |           | 28   |      |           | 28.5 |      |           | 33   |      |           | 33.5 |      | dBm   |
| Supply Current (Idd)                     |           | 47   | 65   |           | 47   | 65   |           | 95   | 126  |           | 95   | 126  | mA    |

[1] Rbias resistor sets current, see application circuit herein

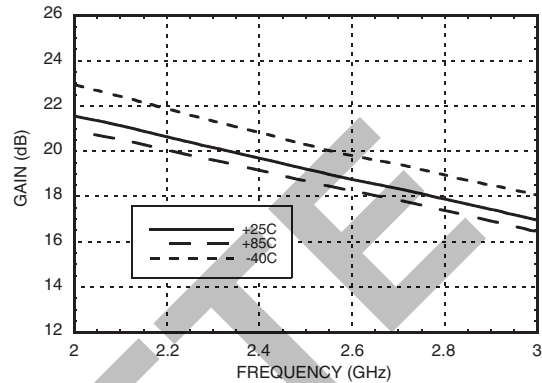


**GaAs PHEMT MMIC LOW NOISE  
AMPLIFIER, 2.1 - 2.9 GHz**

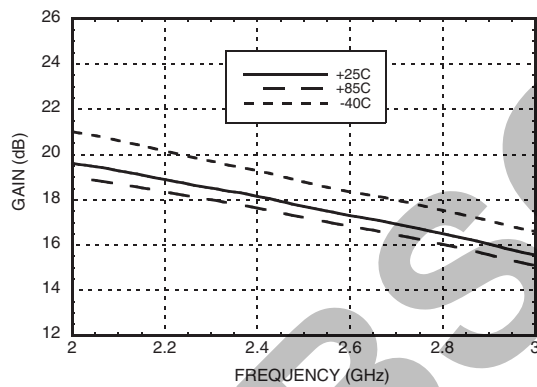
**Broadband Gain & Return Loss [1] [2]**



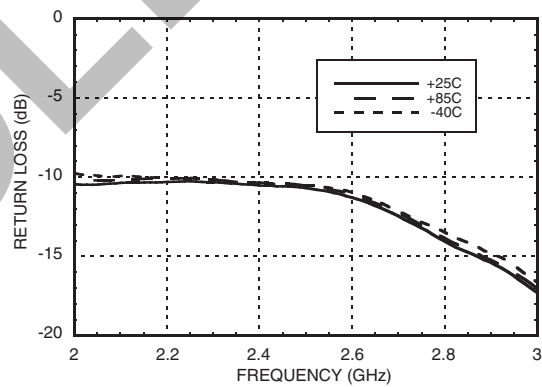
**Gain vs. Temperature [1]**



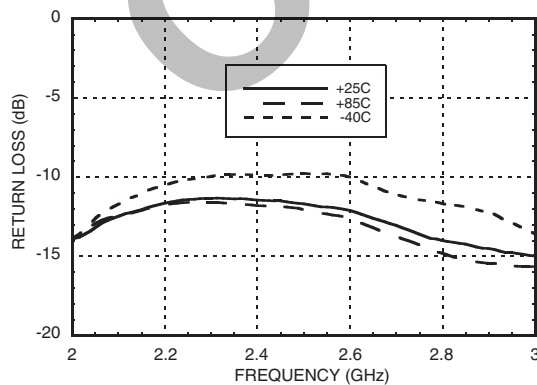
**Gain vs. Temperature [2]**



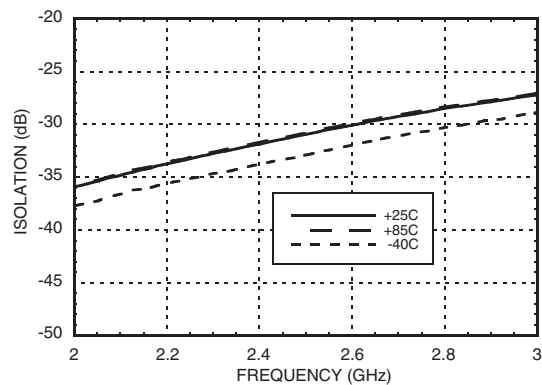
**Input Return Loss vs. Temperature [1]**



**Output Return Loss vs. Temperature [1]**



**Reverse Isolation vs. Temperature [1]**



[1] Vdd = 5V, Rbias = 2kΩ [2] Vdd = 3V, Rbias = 47kΩ

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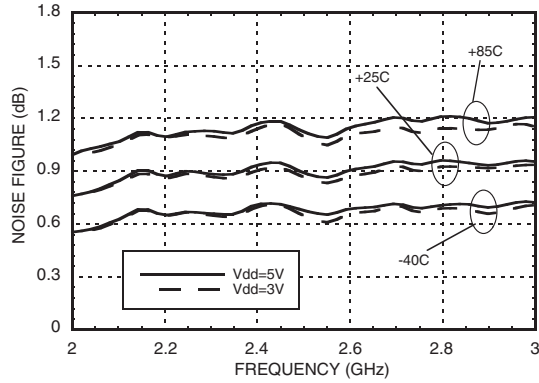
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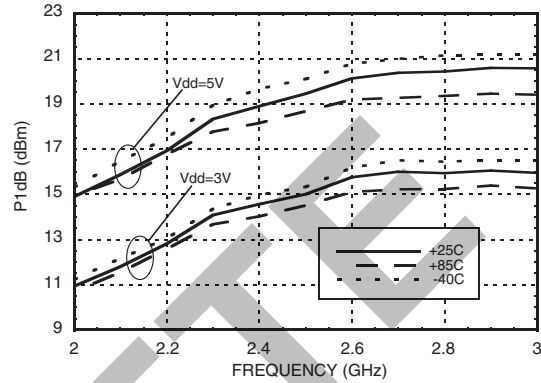
**HMC715LP3 / 715LP3E**

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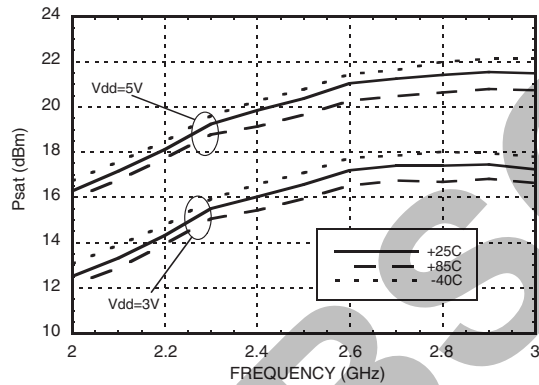
**Noise Figure vs. Temperature [1] [2] [4]**



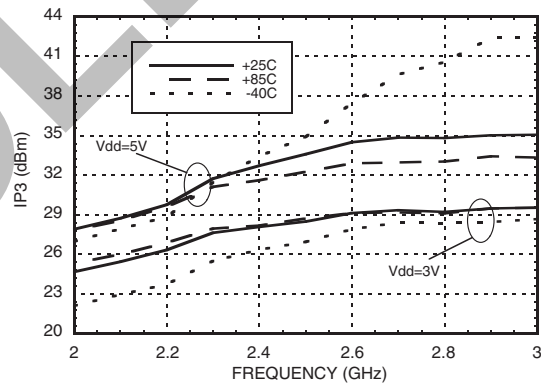
**P1dB vs. Temperature [1] [2]**



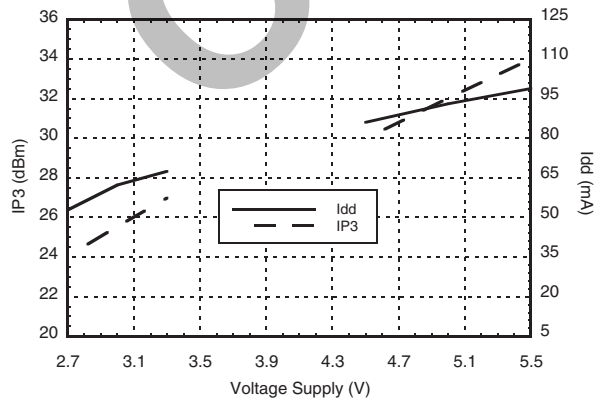
**Psat vs. Temperature [1] [2]**



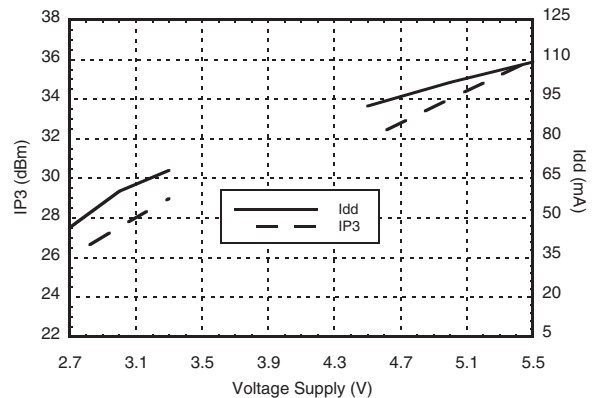
**Output IP3 vs. Temperature [1] [2]**



**Output IP3 and Supply Current vs. Supply Voltage @ 2300 MHz [3]**



**Output IP3 and Supply Current vs. Supply Voltage @ 2700 MHz [3]**



[1] Vdd = 5V, Rbias = 2kΩ [2] Vdd = 3V, Rbias = 47kΩ

[3] Rbias = 2kΩ for Vdd = 5V, Rbias = 47kΩ for Vdd = 3V [4] Measurement reference plane shown on evaluation PCB drawing.

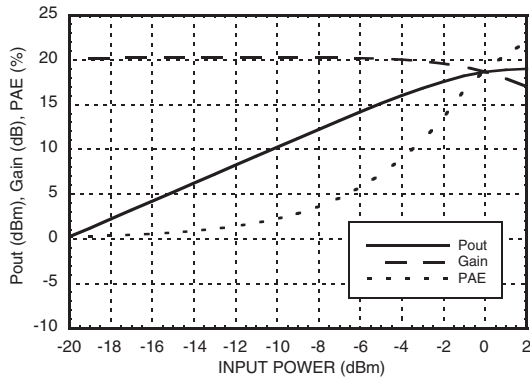
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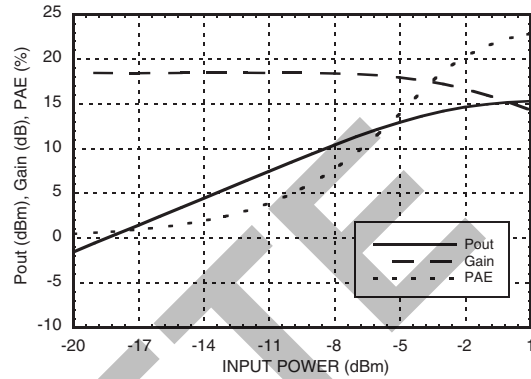


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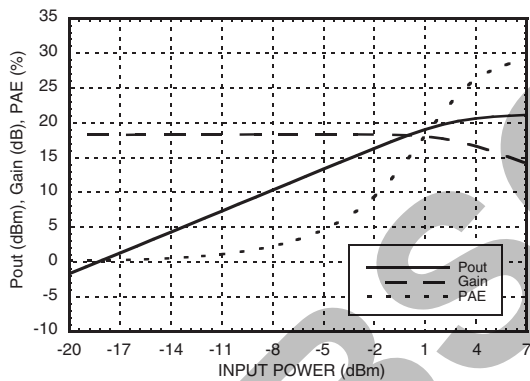
**Power Compression @ 2300 MHz [1]**



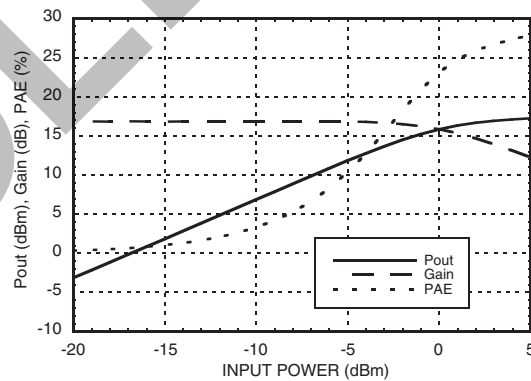
**Power Compression @ 2300 MHz [2]**



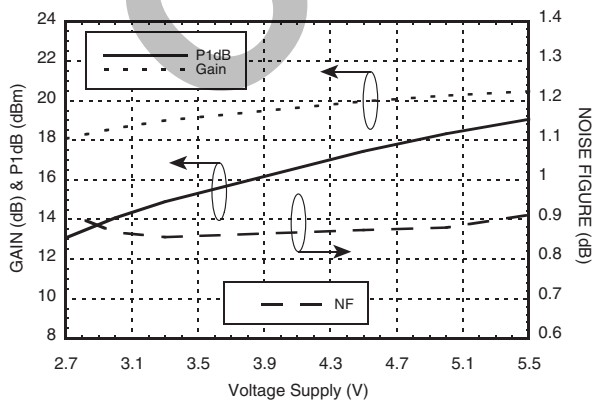
**Power Compression @ 2700 MHz [1]**



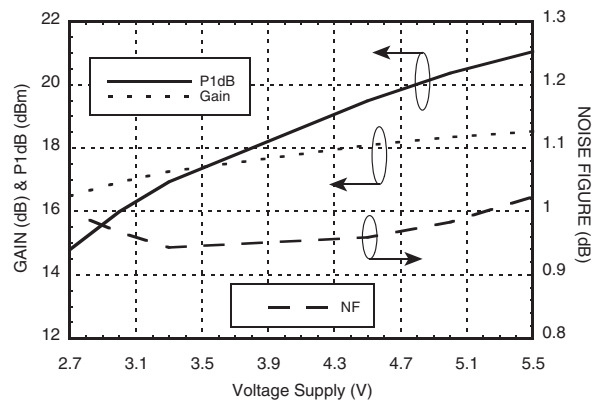
**Power Compression @ 2700 MHz [2]**



**Gain, Power & Noise Figure vs. Supply Voltage @ 2300 MHz [3]**



**Gain, Power & Noise Figure vs. Supply Voltage @ 2700 MHz [3]**



[1] Vdd = 5V, Rbias = 2kΩ [2] Vdd = 3V, Rbias = 47kΩ [3] Rbias = 2kΩ for Vdd = 5V, Rbias = 47kΩ for Vdd = 3V

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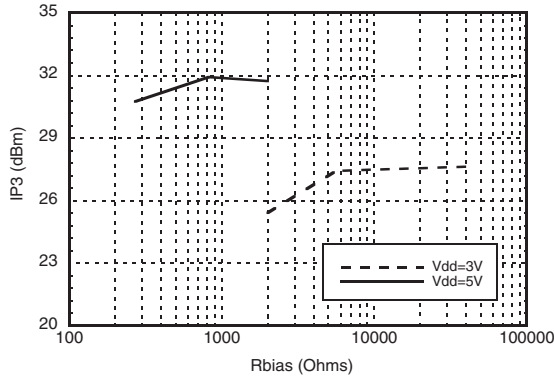
**HMC715LP3 / 715LP3E**

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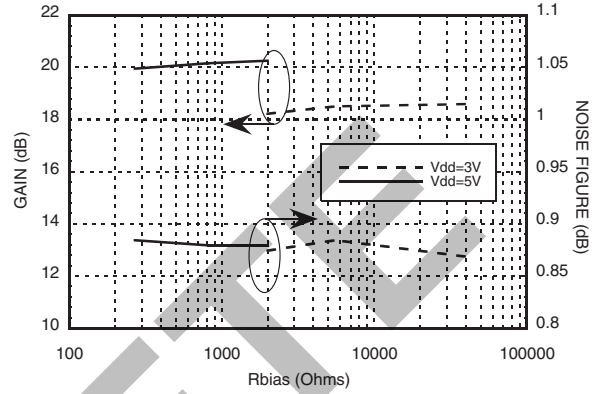
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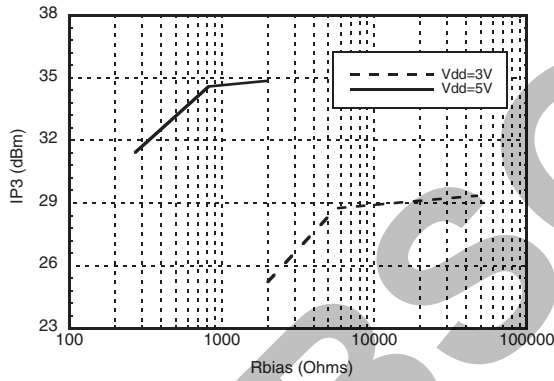
**Output IP3 vs. Rbias @ 2300 MHz**



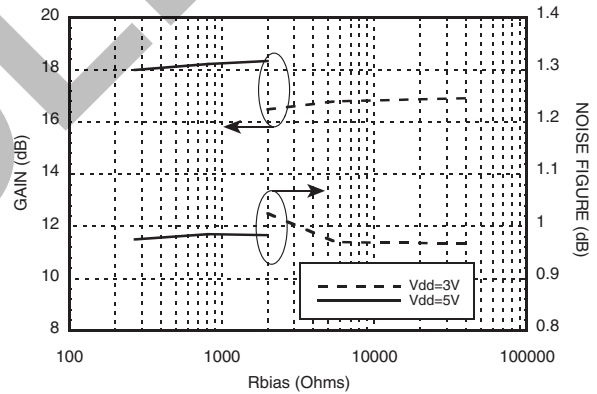
**Gain, Noise Figure & Rbias @ 2300 MHz**



**Output IP3 vs. Rbias @ 2700 MHz**



**Gain, Noise Figure & Rbias @ 2700 MHz**



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**Absolute Bias Resistor  
Range & Recommended Bias Resistor Values**

| Vdd (V) | Rbias (Ohms) |              |             | Idd (mA) |
|---------|--------------|--------------|-------------|----------|
|         | Min          | Max          | Recommended |          |
| 3V      | 1.8k [1]     | Open Circuit | 2K          | 28       |
|         |              |              | 5.6K        | 40       |
|         |              |              | 47K         | 47       |
| 5V      | 0            | Open Circuit | 270         | 61       |
|         |              |              | 820         | 81       |
|         |              |              | 2K          | 95       |

[1] With Vdd= 3V and Rbias < 1.8k Ohms may result in the part becoming conditionally stable which is not recommended.

**Absolute Maximum Ratings**

|  |                |
|--|----------------|
| Drain Bias Voltage (Vdd)                                       | +5.5V          |
| RF Input Power (RFIN)<br>(Vdd = +5 Vdc)                        | +10 dBm        |
| Channel Temperature  | 150 °C         |
| Continuous Pdiss (T= 85 °C)<br>(derate 11.1 mW/°C above 85 °C) | 0.72 W         |
| Thermal Resistance<br>(channel to ground paddle)               | 90 °C/W        |
| Storage Temperature  | -65 to +150 °C |
| Operating Temperature  | -40 to +85 °C  |
| ESD Sensitivity (HBM)  | Class 1A       |



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**Typical Supply Current vs. Supply Voltage**

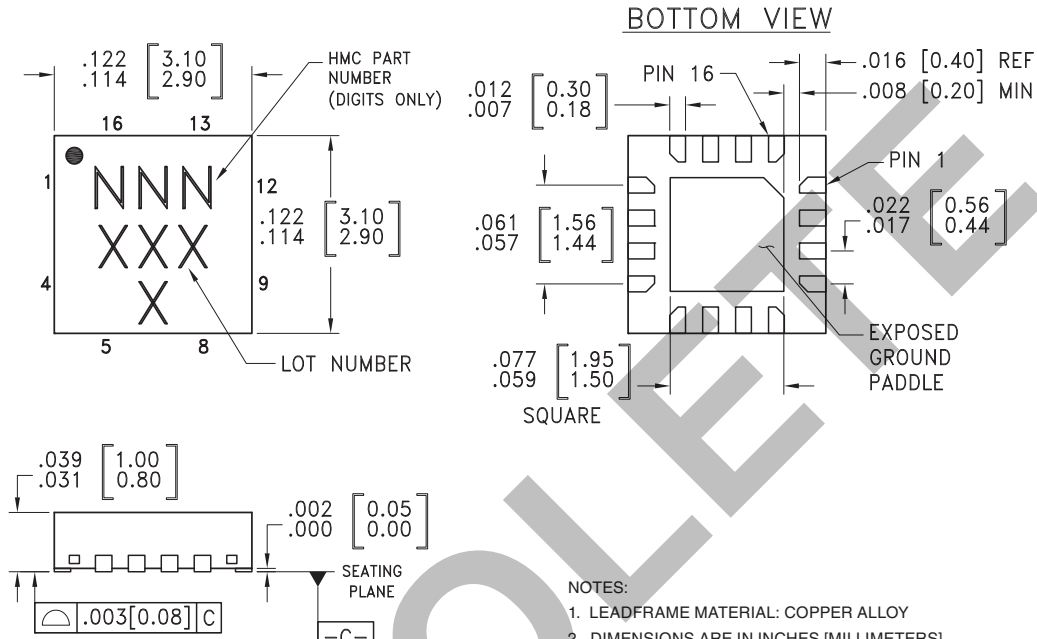
(Rbias = 2k for Vdd = 5V, Rbias = 47k for Vdd = 3V)

| Vdd (V) | Idd (mA) |
|---------|----------|
| 2.7     | 35       |
| 3.0     | 47       |
| 3.3     | 57       |
| 4.5     | 80       |
| 5.0     | 95       |
| 5.5     | 110      |

Note: Amplifier will operate over full voltage ranges shown above.



**Outline Drawing**



**NOTES:**

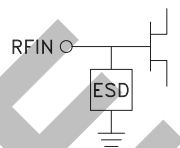
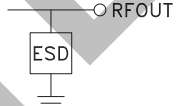
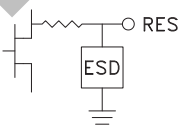
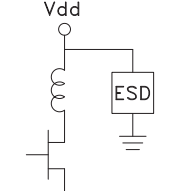

1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE
4. PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM. PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
5. PACKAGE WARP SHALL NOT EXCEED 0.05mm.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED 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 [3] |
|-------------|--|---------------|------------|---------------------|
| HMC715LP3   | Low Stress Injection Molded Plastic                | Sn/Pb Solder  | MSL1 [1]   | 715<br>XXXX         |
| HMC715LP3E  | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 [2]   | 715<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, 3 - 7, 9, 10, 12 - 14, 16 | N/C      | No connection required. These pins may be connected to RF/DC ground without affecting performance.                       |   |
| 2                            | RFIN     | This pin is DC coupled. See application circuit for off chip component.  |    |
| 11                           | RFOUT    | This pin is DC coupled. See application circuit for off chip component.  |    |
| 8                            | RES      | This pin is used to set the DC current of the amplifier by selection of external bias resistor. See application circuit. |    |
| 15                           | Vdd      | Power supply voltage. Bypass capacitors are required. See application circuit.   |   |
|                              | GND      | Ground paddle must be connected to RF/DC ground.   |  |

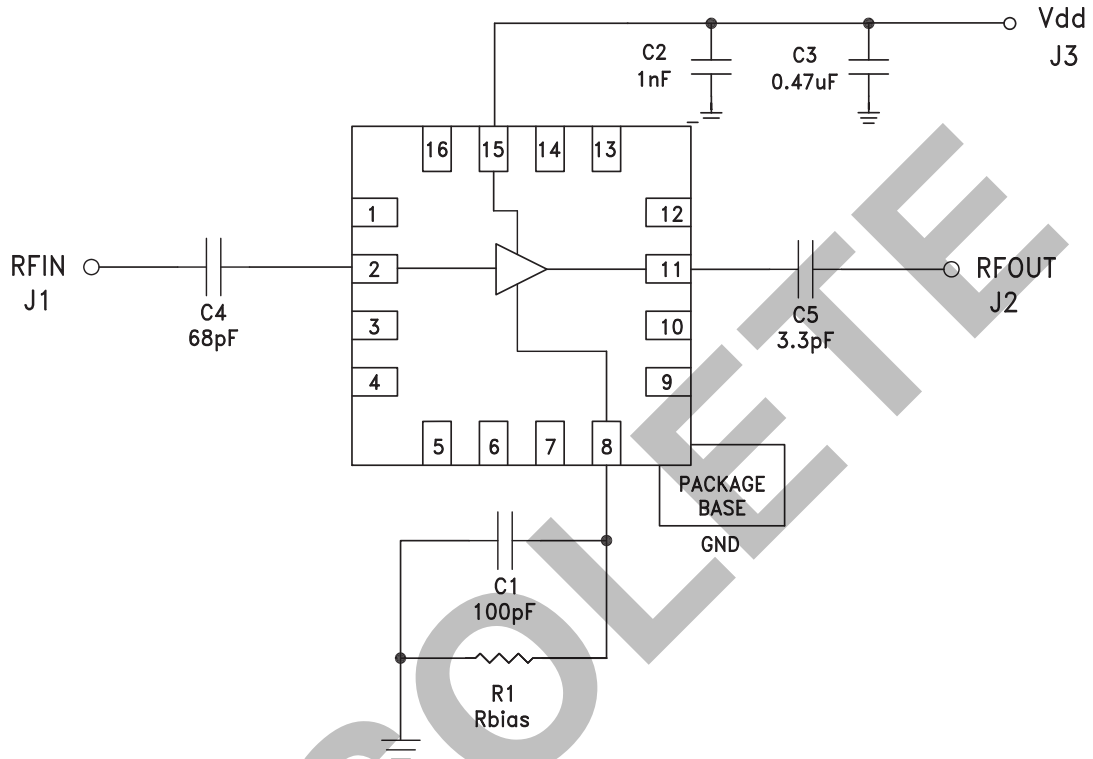


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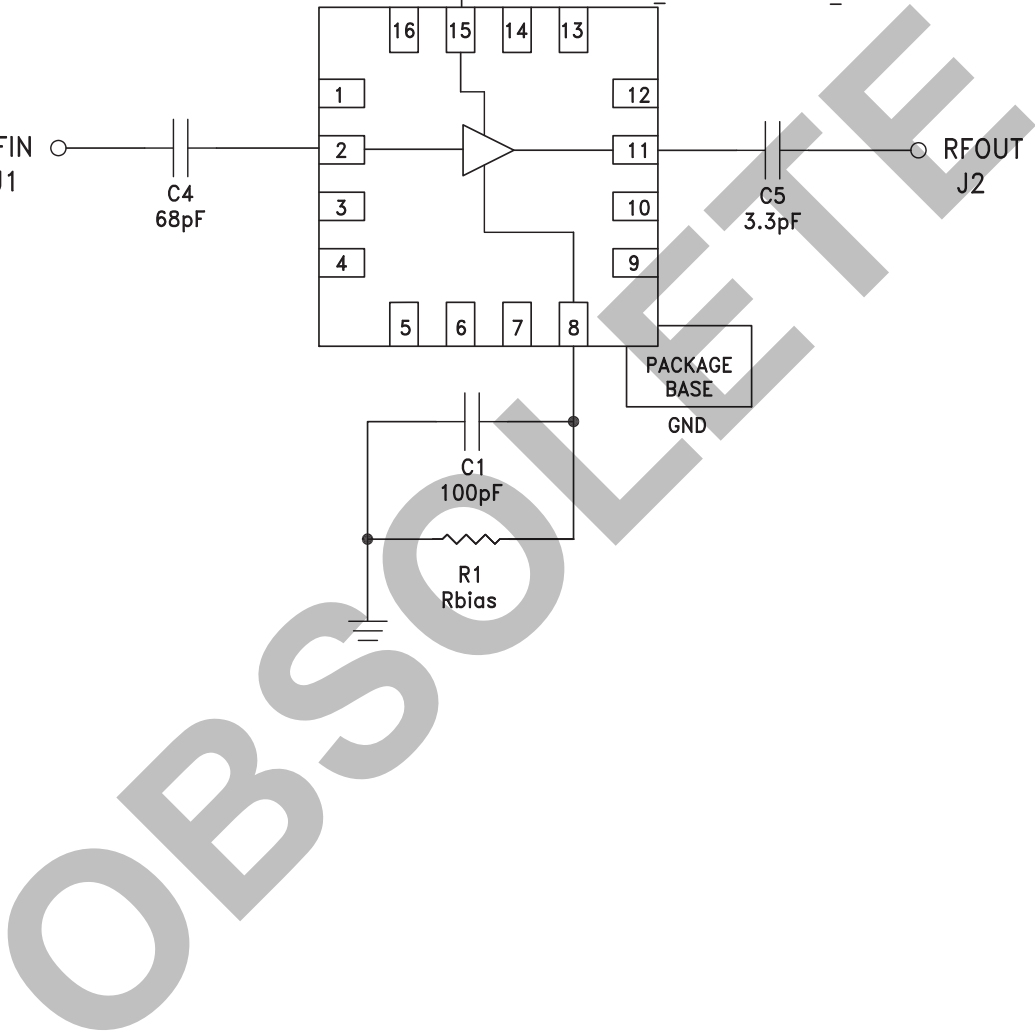


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**Application Circuit**

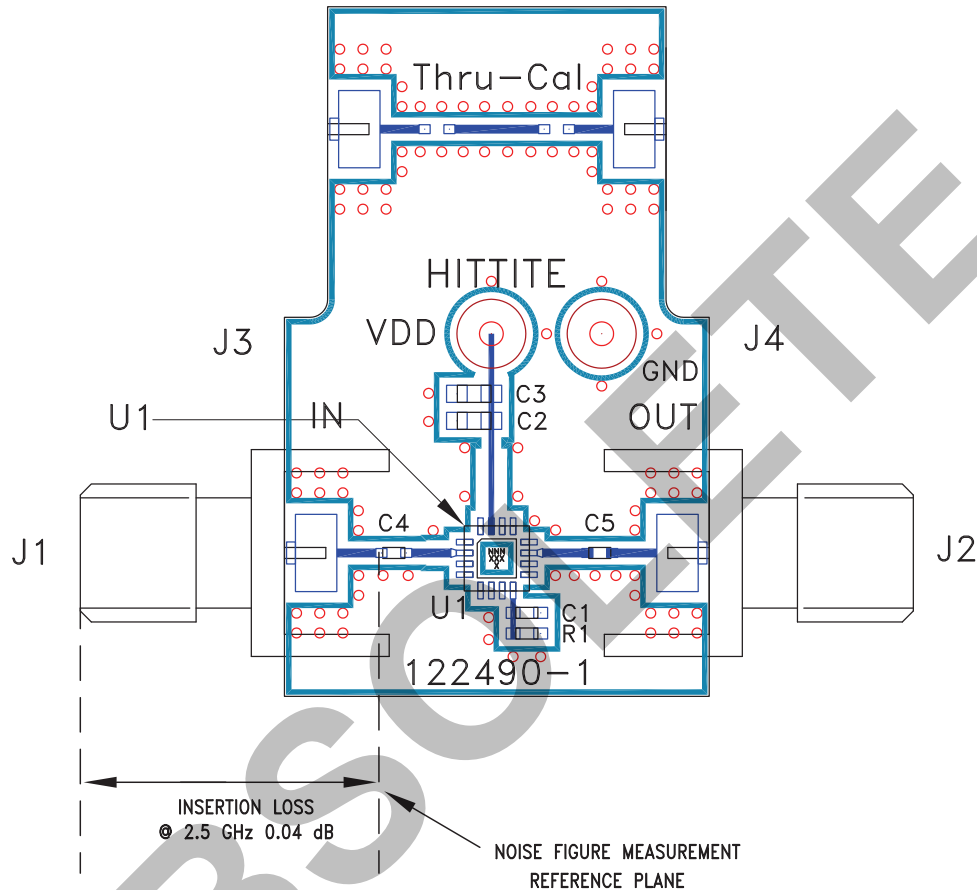


AMPLIFIERS - LOW NOISE - SMT





**Evaluation PCB**



**List of Materials for Evaluation PCB 122492 [1]**

| Item    | Description                  |
|---------|------------------------------|
| J1, J2  | PCB Mount SMA RF Connector   |
| J3, J4  | DC Pin                       |
| C1      | 100pF Capacitor, 0402 Pkg.   |
| C2      | 1000 pF Capacitor, 0603 Pkg. |
| C3      | 0.47µF Capacitor, 0603 Pkg.  |
| C4      | 68pF Capacitor, 0402 Pkg.    |
| C5      | 3.3pF Capacitor, 0402 Pkg.   |
| R1      | 2kΩ Resistor, 0402 Pkg.      |
| U1      | HMC715LP3(E) Amplifier       |
| PCB [2] | 122490 Evaluation PCB        |

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.

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350. or Arlon 25R

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