# HMC593LP3 / 593LP3E

v03.0309

## GaAs PHEMT MMIC LOW NOISE AMPLIFIER w/ BYPASS MODE, 3.3 - 3.8 GHz

OBSOLETE

### Typical Applications

The HMC593LP3(E) is ideal for:

- Wireless Infrastructure
- Fixed Wireless
- WiMAX WiBro / 4G
- Tower Mounted Amplifiers

### Features

Noise Figure: 1.2 dB

Output IP3: +29 dBm

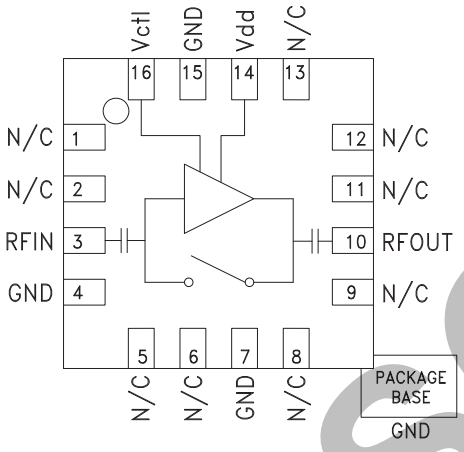
Gain: 19 dB

Low Loss LNA Bypass Path

Single Supply: +3V or +5V

50 Ohm Matched Output

### Functional Diagram




### General Description

The HMC593LP3(E) is a versatile, high dynamic range GaAs MMIC Low Noise Amplifier that integrates a low loss LNA bypass mode on the IC. The amplifier is ideal for WiBro & WiMAX receivers operating between 3.3 and 3.8 GHz and provides 1.2 dB noise figure, 19 dB of gain and +29 dBm IP3 from a single supply of +5V @ 40mA. Input and output return losses are 23 and 13 dB respectively with no external matching components required. A single control line (0/Vdd) is used to switch between LNA mode and a low 2 dB loss bypass mode reducing the current consumption to 10 µA.

### Electrical Specifications, $T_A$ = +25° C

| Parameter | Vdd = +3V | | | | | | Vdd = +5V | | | | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LNA Mode | | | Bypass Mode | | | LNA Mode | | | Bypass Mode | | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| Frequency Range | 3.3 - 3.8 | | | | | | | | | | | | GHz |
| Gain | 14 | 17 | | -3 | -2 | | 16 | 19 | | -3 | -2 | | dB |
| Gain Variation Over Temperature | | 0.011 | | | 0.002 | | | 0.011 | | | 0.002 | | dB / °C |
| Noise Figure | | 1.4 | 1.8 | | | | | 1.2 | 1.6 | | | | dB |
| Input Return Loss | | 23 | | | 30 | | | 23 | | | 30 | | dB |
| Output Return Loss | | 12 | | | 25 | | | 13 | | | 25 | | dB |
| Reverse Isolation | | 39 | | | | | | 36 | | | | | dB |
| Power for 1dB Compression (P1dB)* | 10 | 13 | | | 30 | | 13 | 16 | | | 30 | | dBm |
| Saturated Output Power (Psat) | | 13.5 | | | | | | 17 | | | | | dBm |
| Third Order Intercept (IP3)* (-20 dBm Input Power per tone, 1 MHz tone spacing) | | 22 | | | | | | 29 | | | | | dBm |
| Supply Current (Idd) | | 20 | 25 | | 0.01 | | | 40 | 50 | | 0.01 | | mA |
| Switching Speed: LNA Mode to Bypass Mode | | 428 | | | | | | 428 | | | | | ns |
| Switching Speed: Bypass Mode to LNA Mode | | | | | 343 | | | | | | 343 | | ns |

* P1dB and IP3 for LNA Mode are referenced to RFOUT while P1dB for Bypass Mode is referenced to RFIN.

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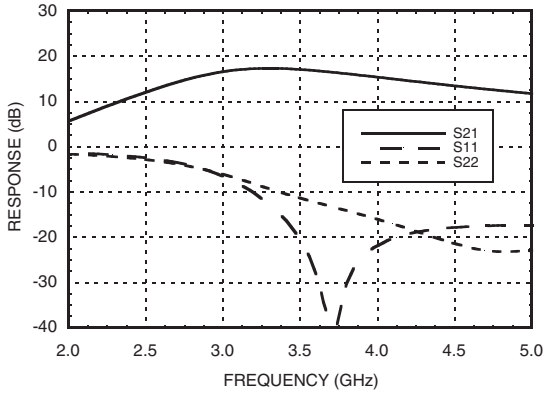
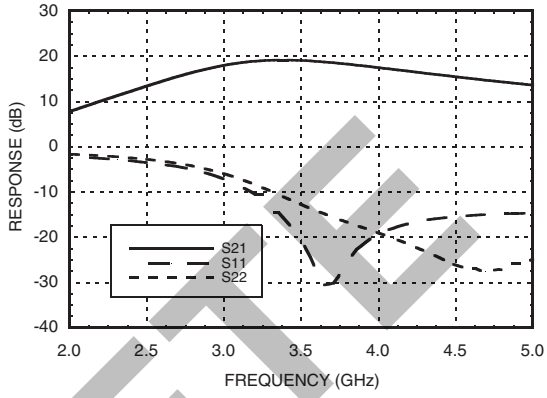
*Application Support: Phone: 1-800-ANALOG-D*

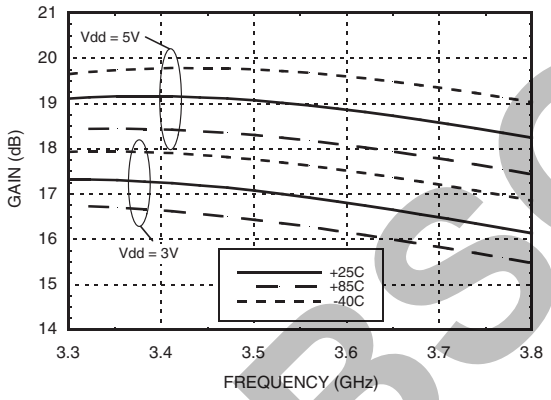
### LNA Broadband Gain & Return Loss @ Vdd= 3V



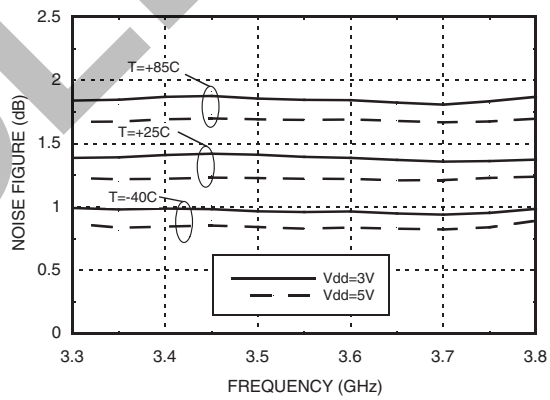

### LNA Broadband Gain & Return Loss @ Vdd= 5V



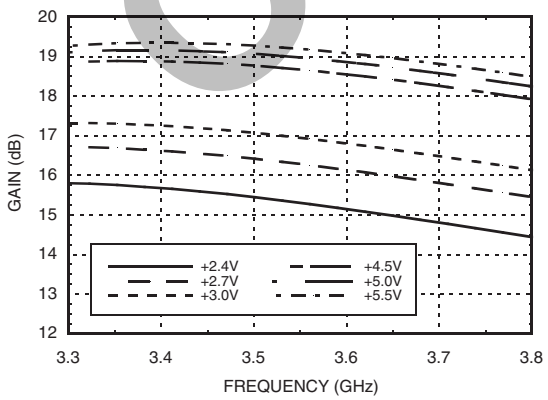

### LNA Gain vs. Temperature



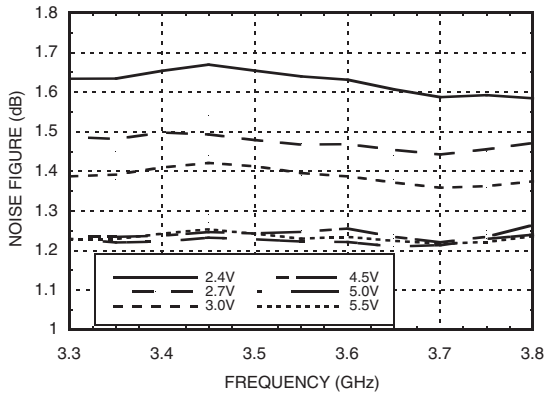

### LNA Noise Figure vs. Temperature




### LNA Gain vs. Vdd




### LNA Noise Figure vs. Vdd

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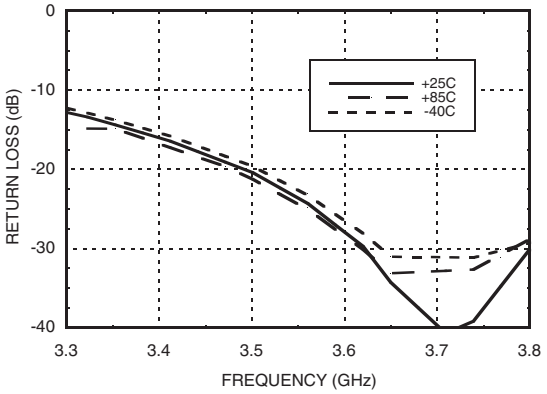
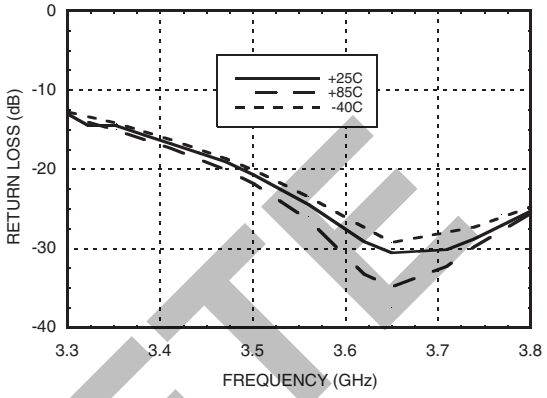
## GaAs PHEMT MMIC LOW NOISE AMPLIFIER w/ BYPASS MODE, 3.3 - 3.8 GHz

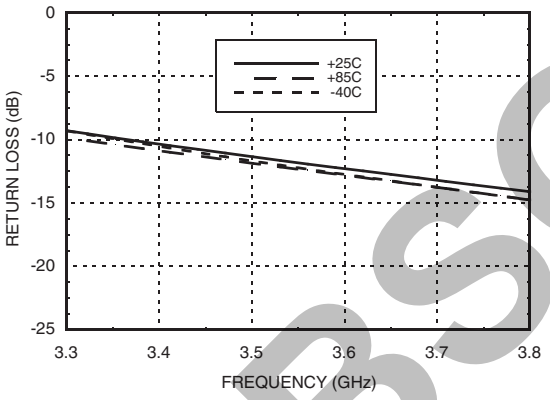
### LNA Input Return Loss vs. Temperature @ Vdd= 3V



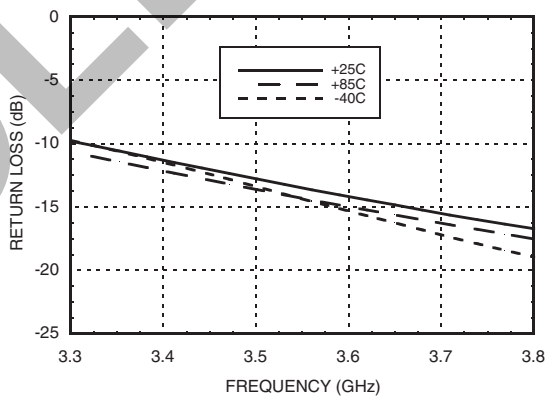

### LNA Input Return Loss vs. Temperature @ Vdd= 5V



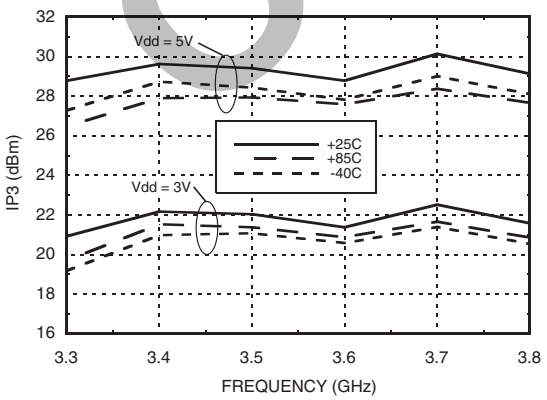

### LNA Output Return Loss vs. Temperature @ Vdd= 3V



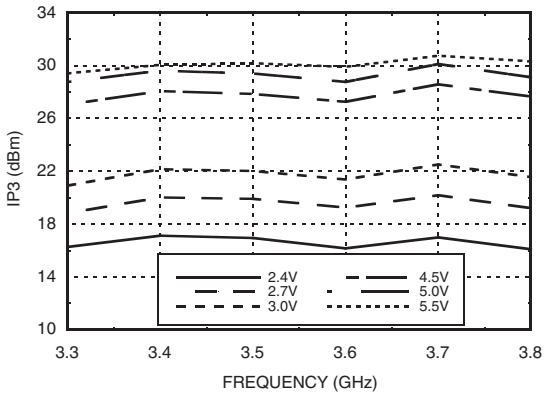

### LNA Output Return Loss vs. Temperature @ Vdd= 5V




### LNA Output IP3 vs. Temperature




### LNA Output IP3 vs. Vdd

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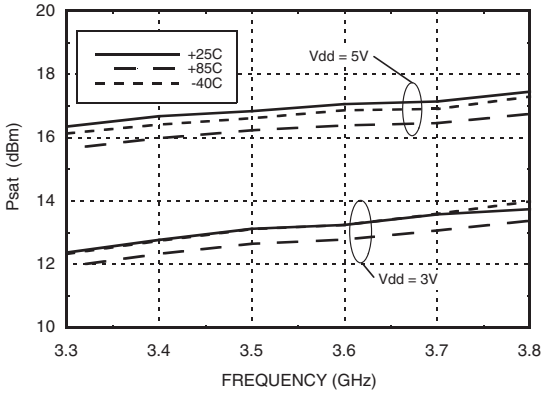
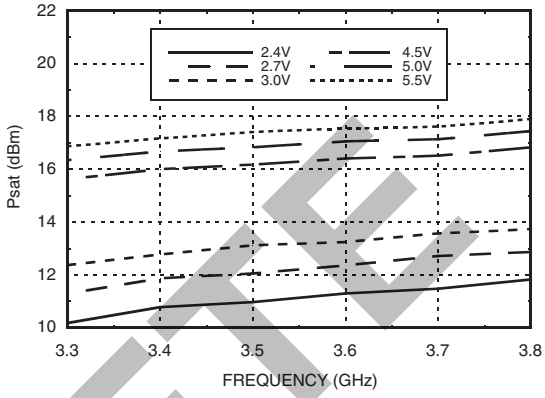
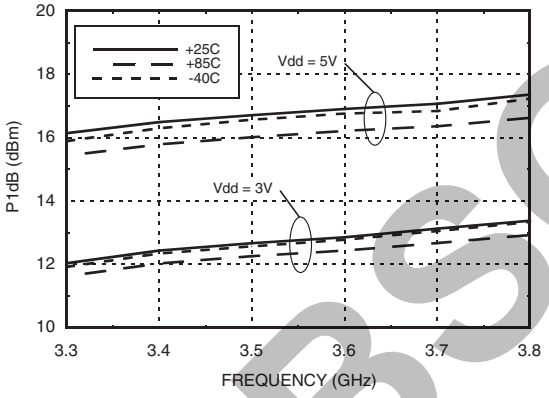
### LNA Psat vs. Temperature



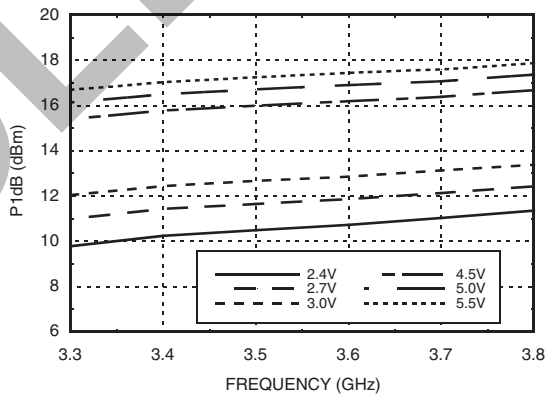

### LNA Psat vs. Vdd



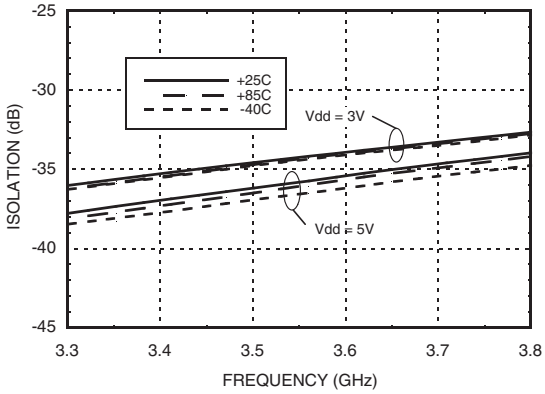

### LNA Output P1dB vs. Temperature




### LNA Output P1dB vs. Vdd




### LNA Reverse Isolation vs. Temperature

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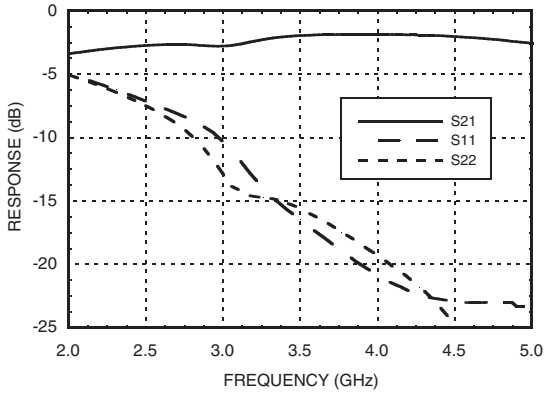
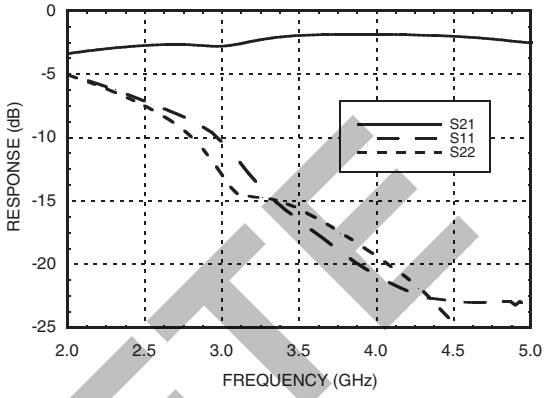
## GaAs PHEMT MMIC LOW NOISE AMPLIFIER w/ BYPASS MODE, 3.3 - 3.8 GHz

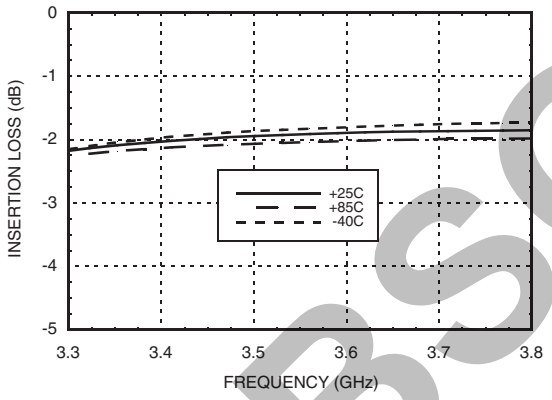
### Bypass Mode Broadband Gain & Return Loss [1]



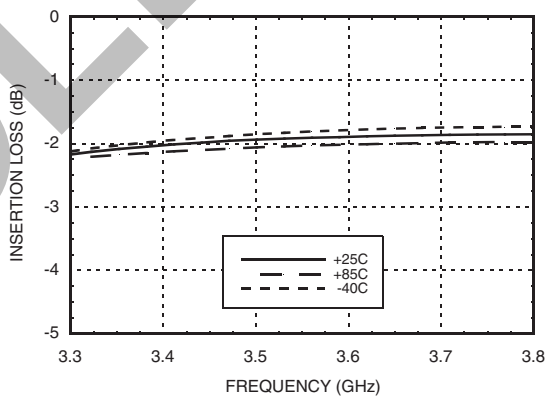

### Bypass Mode Broadband Gain & Return Loss [2]



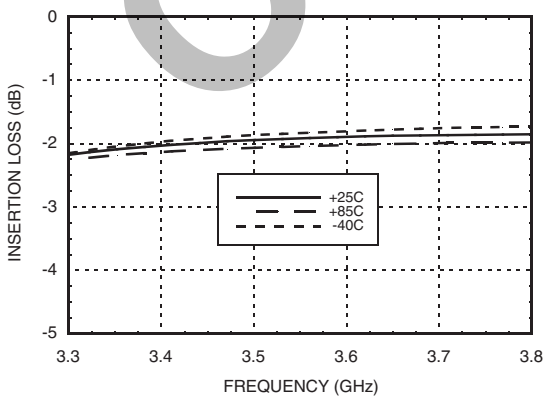

### Bypass Mode Insertion Loss vs. Temperature [1]



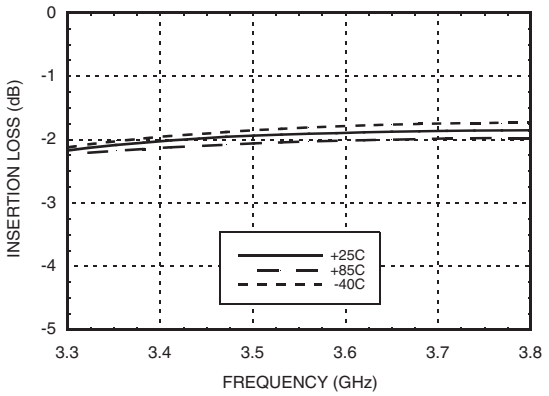

### Bypass Mode Insertion Loss vs. Temperature [2]




### Bypass Mode, Input IP3 vs. Temperature




### Bypass Mode, P1dB vs. Temperature

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[1] Vdd = 3V [2] Vdd = 5V

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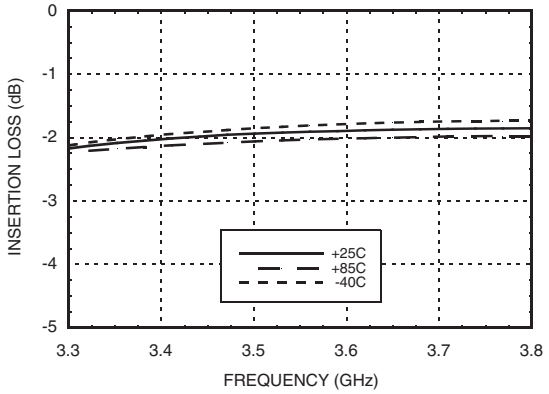
### Bypass Mode, Psat vs. Temperature




### Typical Supply Current vs. Vdd

| Vdd (V) | Idd (mA) |
|---|---|
| +2.4 | 9 |
| +2.7 | 12 |
| +3.0 | 16 |
| +4.5 | 33 |
| +5.0 | 39 |
| +5.5 | 44 |

### Absolute Maximum Ratings

| | |
|---|---|
| Drain Bias Voltage (Vdd) | +8 V |
| RF Input Power (RFIN) (Vdd = +5.0 Vdc) LNA Mode / Bypass Mode | +15 dBm / +30 dBm |
| Channel Temperature | 150 °C |
| Continuous Pdiss (T = 85 °C) (derate 13 mW/°C above 85 °C) | 850 mW |
| Thermal Resistance (channel to ground paddle) | 76.9 °C/W |
| Storage Temperature | -65 to +150° C |
| Operating Temperature | -40 to +85° C |
| ESD Sensitivity (HBM) | Class 1A |

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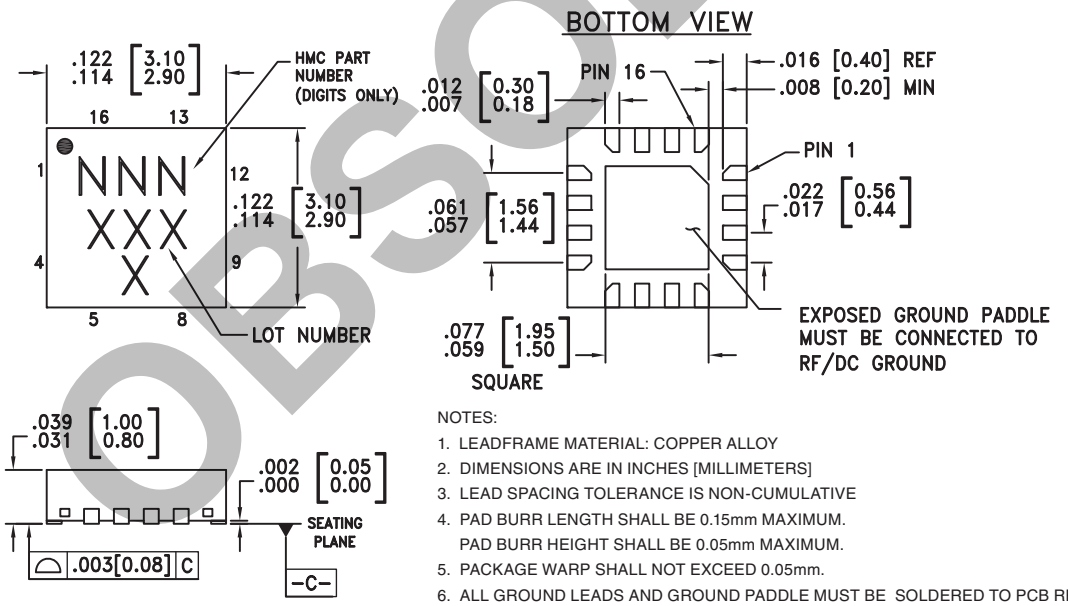
### Outline Drawing




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 [3] |
|---|---|---|---|---|
| HMC593LP3 | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 [1] | 593<br>XXXX |
| HMC593LP3E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 [2] | 593<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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# HMC593LP3 / 593LP3E

v03.0309

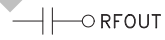
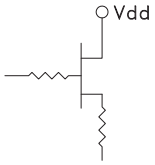
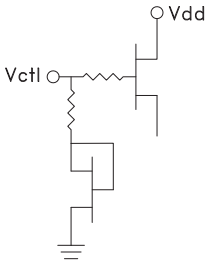
## GaAs PHEMT MMIC LOW NOISE AMPLIFIER w/ BYPASS MODE, 3.3 - 3.8 GHz

### Truth Table

| | |
|---|---|
| LNA Mode | Vctl= Vdd |
| Bypass Mode | Vctl= 0V |

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

### Pin Descriptions

| Pin Number | Function | Description | Interface Schematic |
|---|---|---|---|
| 1, 2, 5, 6, 8, 9, 11 - 13 | N/C | No connection necessary. These pins may be connected to RF/DC ground. | |
| 3 | RFIN | This pin is AC coupled and matched to 50 Ohms. |   |
| 4, 7, 15 | GND | These pins must be connected to RF/DC ground. |   |
| 10 | RFOUT | This pin is AC coupled and matched to 50 Ohms. |   |
| 14 | Vdd | Power supply voltage. Bypass capacitors are required. See application circuit. |   |
| 16 | Vctl | LNA/Bypass Mode Control Voltage. See truth table. |   |

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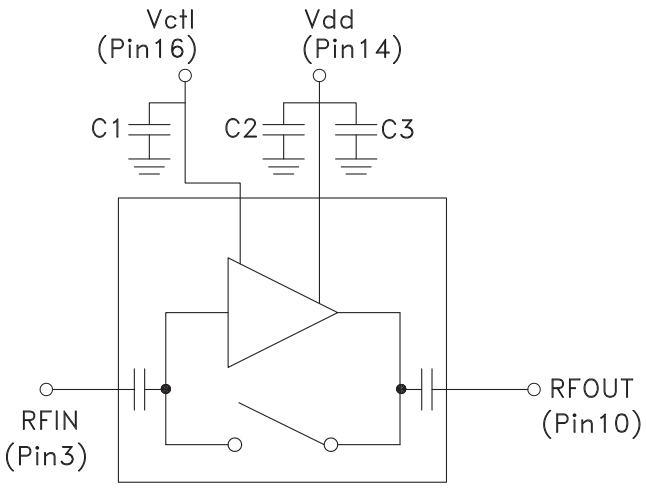
### Application Circuit

| Component | Value |
|---|---|
| C1, C2 | 100pF |
| C3 | 10KpF |

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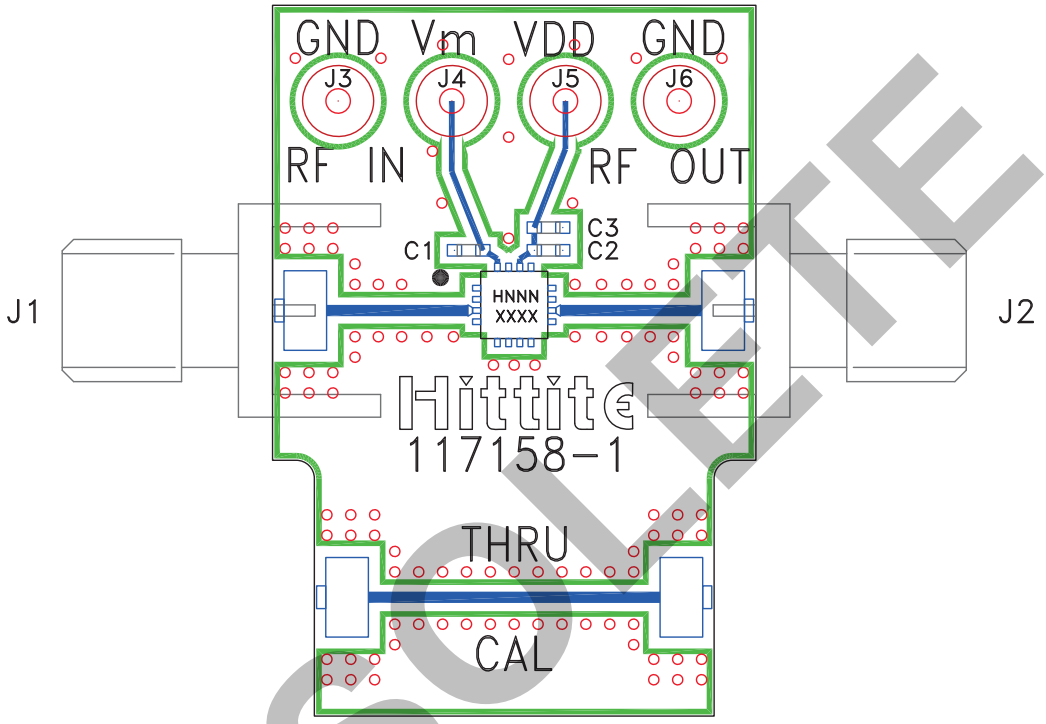
## Evaluation PCB

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## List of Materials for Evaluation PCB 117160 [1]

| Item | Description |
|---|---|
| J1 - J2 | PCB Mount SMA RF Connector |
| J3 - J6 | DC Pin |
| C1, C2 | 100 pF Capacitor, 0402 Pkg. |
| C3 | 10 KpF Capacitor, 0402 Pkg. |
| U1 | HMC593LP3 / HMC593LP3E Amplifier |
| PCB [2] | 117158 Evaluation Board |

[1] Reference this number when ordering complete evaluation PCB

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

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 circuit board shown is available from Hittite upon request.

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