



## GaAs HEMT MMIC LOW NOISE AMPLIFIER, 14 - 27 GHz

### Typical Applications

This HMC504LC4B is ideal for:

- Point-to-Point Radios
- Point-to-Multi-Point Radios
- Military & Space
- Test Instrumentation

### Features

Noise Figure: 2.2 dB @ 20 GHz

Gain: 19 dB

P1dB Output Power: +17 dBm

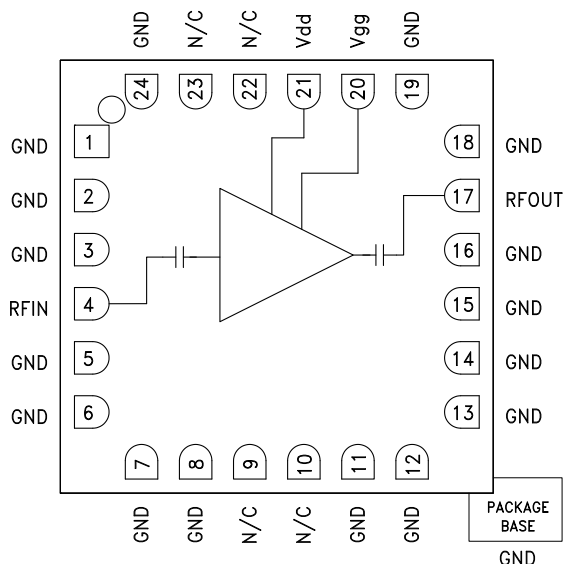
Supply Voltage: +4V @ 90mA

Output IP3: +26 dBm

50 Ohm matched Input/Output

24 Lead 4x4mm SMT Package: 16mm<sup>2</sup>

### Functional Diagram



### General Description

The HMC504LC4B is a GaAs MMIC Low Noise Wideband Amplifier housed in a leadless 4x4 mm ceramic surface mount package. The amplifier operates between 14 and 27 GHz, providing up to 19 dB of small signal gain, 2.2 dB noise figure, and output IP3 of +26 dBm, while requiring only 90 mA from a +4V supply. The P1dB output power of up to +17 dBm enables the LNA to function as a LO driver for balanced, I/Q or image reject mixers. The HMC504LC4B also features I/Os that are DC blocked and internally matched to 50 Ohms, making it ideal for high capacity microwave radios or VSAT applications. This versatile LNA is also available in die form as the HMC-ALH476.

### Electrical Specifications, $T_A = +25^\circ\text{C}$ , $V_{dd} = +4\text{V}$ , $I_{dd} = 90\text{ mA}$ <sup>[2]</sup>

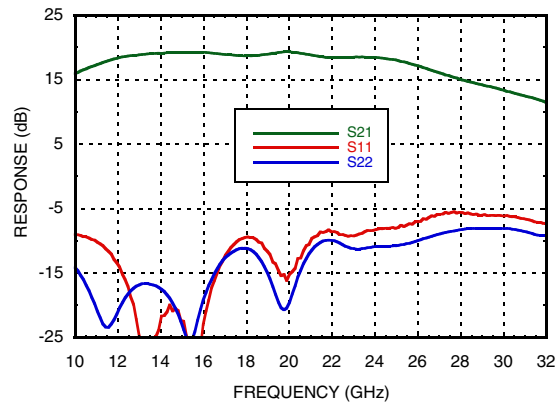
| Parameter                                                                                 | Min.    | Typ.  | Max. | Min.    | Typ.  | Max. | Min.    | Typ.  | Max. | Units   |
|-------------------------------------------------------------------------------------------|---------|-------|------|---------|-------|------|---------|-------|------|---------|
| Frequency Range                                                                           | 14 - 20 |       |      | 20 - 24 |       |      | 24 - 27 |       |      | GHz     |
| Gain <sup>[1]</sup>                                                                       | 16.5    | 19    |      | 16      | 18.5  |      | 14      | 17    |      | dB      |
| Gain Variation over Temperature                                                           |         | 0.015 |      |         | 0.017 |      |         | 0.018 |      | dB / °C |
| Noise Figure <sup>[1]</sup>                                                               |         | 2.2   | 3    |         | 2.5   | 4.2  |         | 4.5   | 6    | dB      |
| Input Return Loss                                                                         |         | 15    |      |         | 9     |      |         | 7     |      | dB      |
| Output Return Loss                                                                        |         | 15    |      |         | 12    |      |         | 9.5   |      | dB      |
| Output Power for 1 dB Compression <sup>[1]</sup>                                          |         | 15    |      |         | 16.5  |      |         | 17    |      | dBm     |
| Saturated Output Power (P <sub>sat</sub> ) <sup>[1]</sup>                                 |         | 19.5  |      |         | 19.5  |      |         | 19    |      | dBm     |
| Output Third Order Intercept (IP3)                                                        |         | 24.5  |      |         | 25.5  |      |         | 26    |      | dBm     |
| Supply Current (I <sub>dd</sub> )<br>(V <sub>dd</sub> = 4V, V <sub>gg</sub> = -0.3V Typ.) |         | 90    |      |         | 90    |      |         | 90    |      | mA      |

[1] Board loss subtracted out for gain, power and noise figure measurement

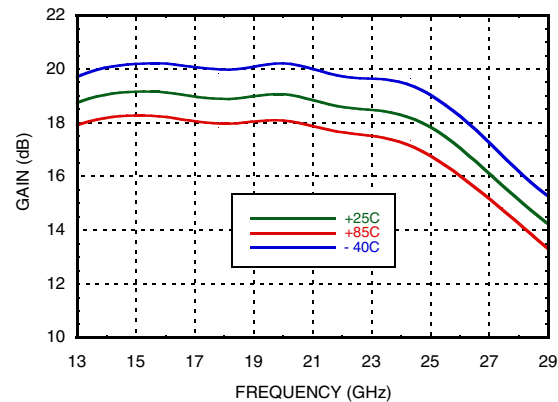
[2] Adjust V<sub>gg</sub> between -1.7 to 0V to achieve I<sub>dd</sub> = 90mA

**GaAs HEMT MMIC LOW NOISE  
AMPLIFIER, 14 - 27 GHz**

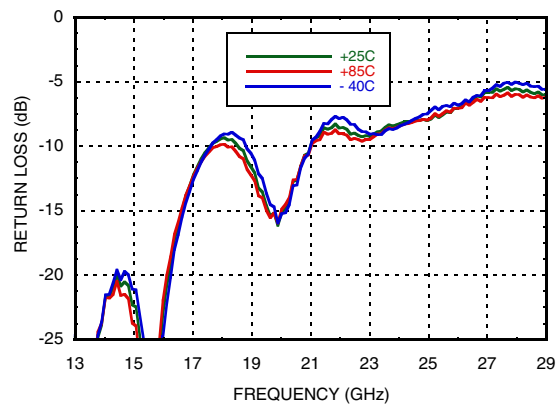
**Broadband Gain & Return Loss <sup>[1]</sup>**



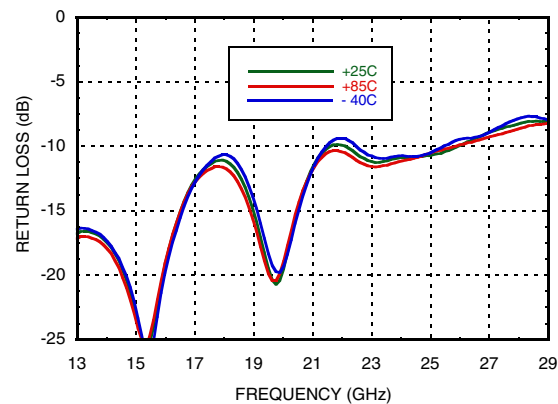
**Gain vs. Temperature <sup>[1]</sup>**



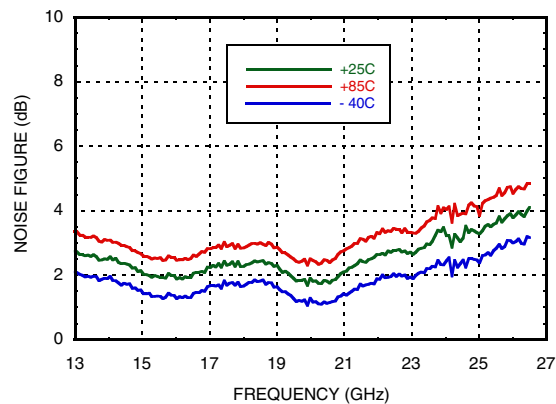
**Input Return Loss vs. Temperature**



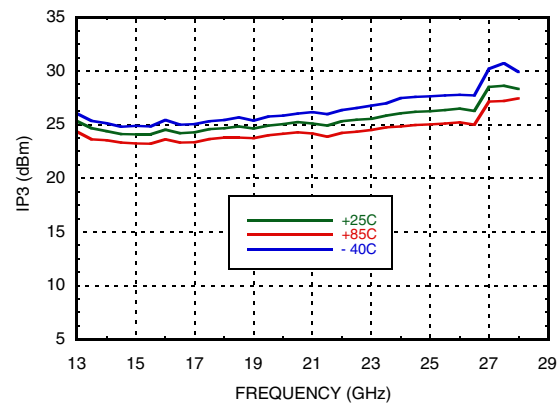
**Output Return Loss vs. Temperature**



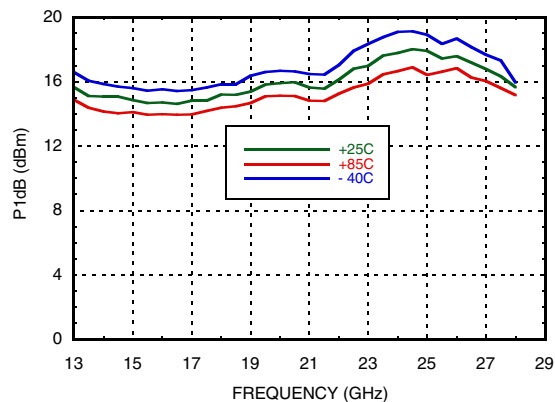
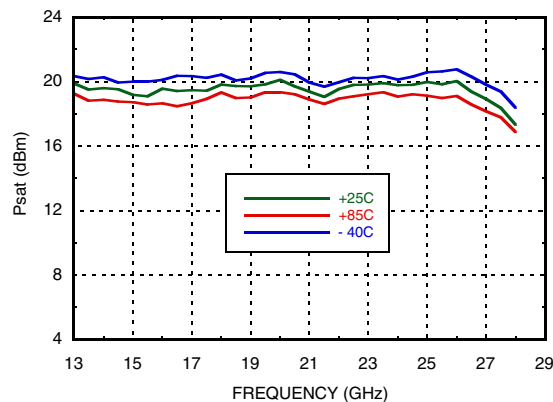
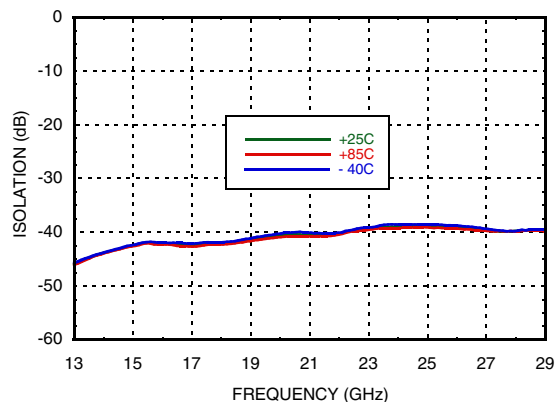
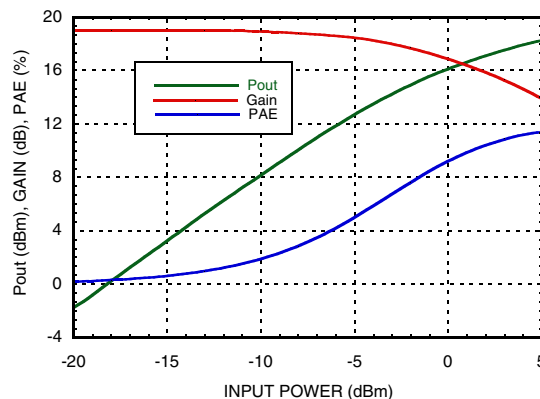
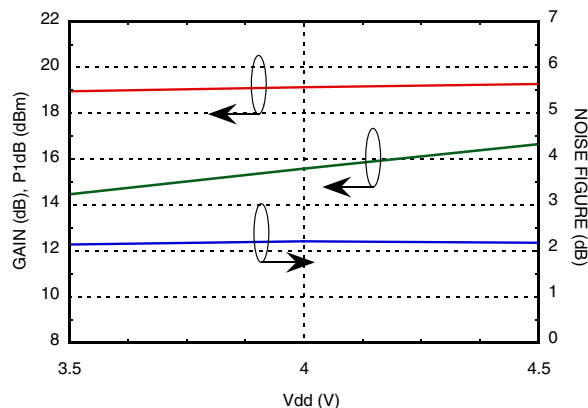
**Noise Figure vs. Temperature <sup>[1]</sup>**



**Output IP3 vs. Temperature**



[1] Board loss subtracted out for gain, power and noise figure measurement

**GaAs HEMT MMIC LOW NOISE  
AMPLIFIER, 14 - 27 GHz**
**P1dB vs. Temperature <sup>[1]</sup>**

**Psat vs. Temperature <sup>[1]</sup>**

**Reverse Isolation vs. Temperature**

**Power Compression @ 21 GHz <sup>[1]</sup>**

**Gain, Noise Figure & Power vs.  
Supply Voltage @ 21 GHz <sup>[1]</sup>**


[1] Board loss subtracted out for gain, power and noise figure measurement

## GaAs HEMT MMIC LOW NOISE AMPLIFIER, 14 - 27 GHz

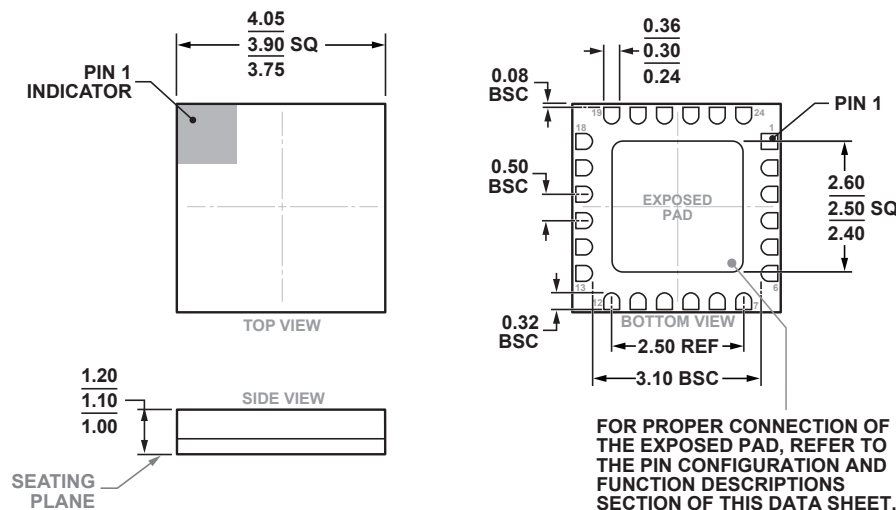
### Absolute Maximum Ratings

|                                                                           |                |
|---------------------------------------------------------------------------|----------------|
| Drain Bias Voltage                                                        | +4.5V          |
| RF Input Power                                                            | +6 dBm         |
| Gate Bias Voltage                                                         | -2 to 0.3V     |
| Channel Temperature                                                       | 180 °C         |
| Continuous P <sub>diss</sub> (T = 85 °C)<br>(derate 20 mW/°C above 85 °C) | 1.9 W          |
| Thermal Resistance<br>(Channel to ground paddle)                          | 50 °C/W        |
| Storage Temperature                                                       | -65 to +150 °C |
| Operating Temperature                                                     | -40 to +85 °C  |
| ESD Sensitivity (HBM)                                                     | Class 1A       |



ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS

### Outline Drawing



24-Terminal Ceramic Leadless Chip Carrier [LCC]  
(E-24-2)  
Dimensions shown in millimeters

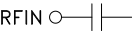
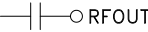
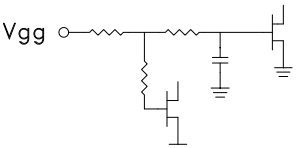
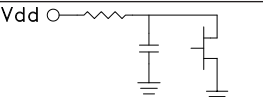
### Package Information

| Part Number | Package Body Material | Lead Finish      | MSL Rating          | Package Marking <sup>[2]</sup> |
|-------------|-----------------------|------------------|---------------------|--------------------------------|
| HMC504LC4B  | Alumina, White        | Gold over Nickel | MSL3 <sup>[1]</sup> | H504<br>XXXX                   |

[1] Max peak reflow temperature of 260 °C

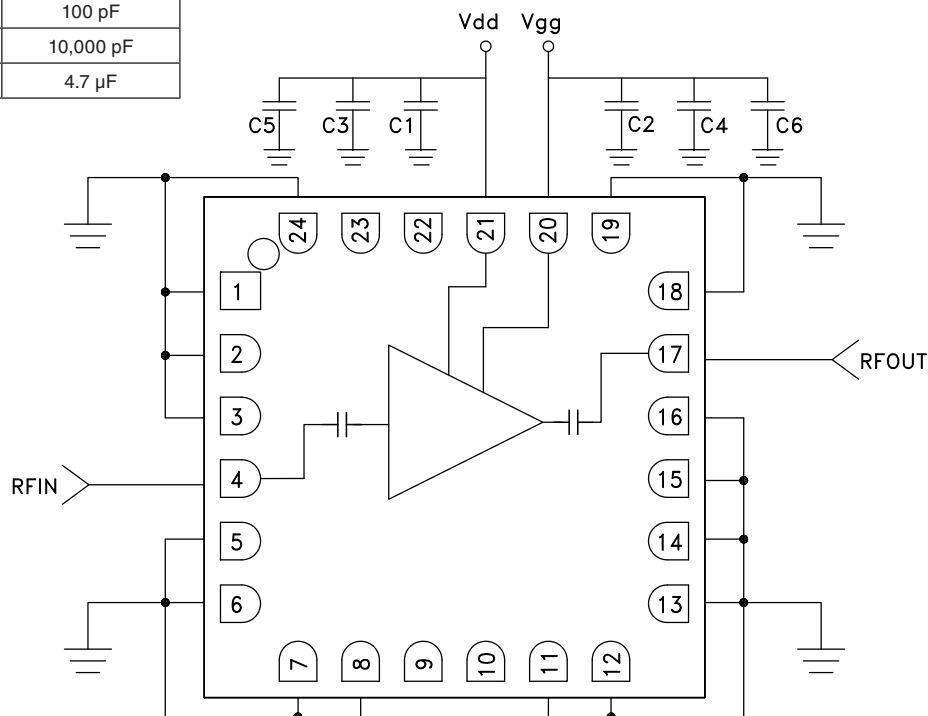
[2] 4-Digit lot number XXXX

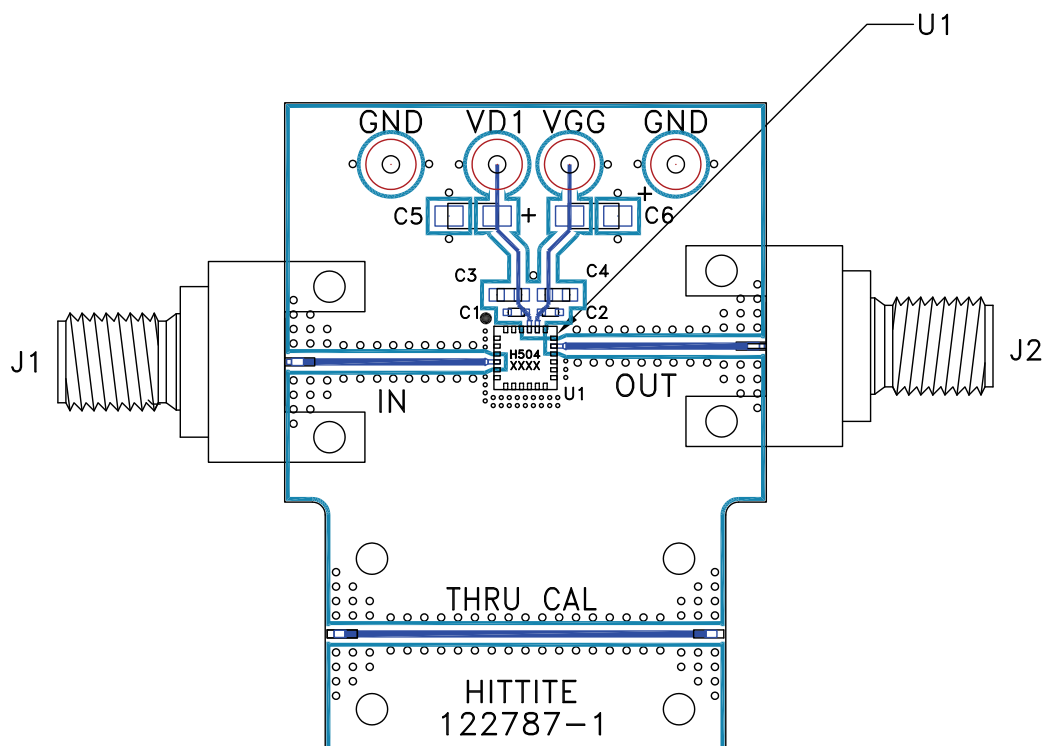
**GaAs HEMT MMIC LOW NOISE  
AMPLIFIER, 14 - 27 GHz**
**Pin Descriptions**

| Pin Number                           | Function | Description                                                                                                                                   | Interface Schematic                                                                 |
|--------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1 - 3, 5 - 8, 11 - 16,<br>18, 19, 24 | GND      | Package bottom has exposed metal paddle that must be connected to RF/DC ground.                                                               |  |
| 4                                    | RFIN     | This pad is AC coupled and matched to 50 Ohms.                                                                                                |  |
| 17                                   | RFOUT    | This pad is AC coupled and matched to 50 Ohms.                                                                                                |  |
| 20                                   | Vgg      | Gate control for amplifier. Please follow "MMIC Amplifier Biasing Procedure" application note. See assembly for required external components. |  |
| 21                                   | Vdd      | Power Supply Voltage for the amplifier. See assembly for required external components.                                                        |  |

**Application Circuit**

| Component | Value       |
|-----------|-------------|
| C1, C2    | 100 pF      |
| C3, C4    | 10,000 pF   |
| C5, C6    | 4.7 $\mu$ F |



**GaAs HEMT MMIC LOW NOISE  
AMPLIFIER, 14 - 27 GHz**
**Evaluation PCB**

**List of Materials for Evaluation PCB 122789 [1]**

| Item    | Description                     |
|---------|---------------------------------|
| J1, J2  | 2.92mm PCB mount K-Connector    |
| J3 - J6 | DC Pin                          |
| C1, C2  | 100 pF Capacitor, 0402 Pkg.     |
| C3, C4  | 10,000pF Capacitor, 0603 Pkg.   |
| C5, C6  | 4.7 $\mu$ F Capacitor, Tantalum |
| U1      | HMC504LC4B Amplifier            |
| PCB [2] | 122787 Evaluation PCB [3]       |

[1] Reference this number when ordering complete evaluation PCB

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

[3] Due to the very high frequency operation of this product a custom LC4B PCB footprint and solder stencil are required for this design. Performance shown in this data sheet was produced using this custom footprint. DO NOT USE Hittite's standard LC4B footprint. Please contact Applications for details.

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 Analog Devices, upon request.