

[查询"HMC271LP4\\_09"供应商](#)


v03.0809



# HMC271LP4 / 271LP4E

## 1 dB LSB GaAs MMIC 5-BIT SERIAL CONTROL DIGITAL ATTENUATOR, 0.7 - 3.7 GHz

### Typical Applications

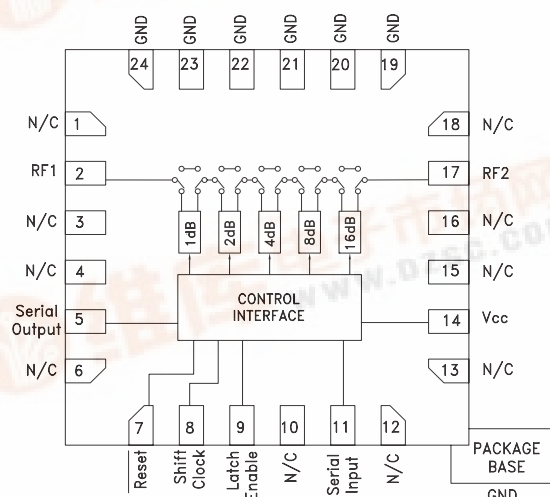
The HMC271LP4 / HMC271LP4E is ideal for:

- Cellular/3G Infrastructure
- Fixed Wireless, WiMax & WiBro
- Test Instrumentation

### Features

- 1 dB LSB Steps to 31 dB
- CMOS Compatible Serial Data Interface
- SPI Compatible Serial Output
- ±0.4 dB Typical Bit Error
- 24 Lead 4x4mm QFN Package: 16mm<sup>2</sup>
- Included in the HMC-DK004 Designer's Kit

### Functional Diagram



### General Description

The HMC271LP4 & HMC271LP4E are broadband 5-bit positive control GaAs IC digital attenuators with CMOS compatible serial-to-parallel drivers in low cost leadless QFN 4x4 mm SMT packages. Covering 0.7 to 3.7 GHz, the insertion loss is typically less than 2.5 dB. The attenuator bit values are 1 (LSB), 2, 4, 8, and 16 dB for a total attenuation of 31 dB. Accuracy is excellent at ± 0.4 dB typical with an IIP3 of up to +48 dBm. Five bit CMOS compatible serial control words are used to select each attenuation state. A single Vcc bias of +3V to +5V applied through an external 5k Ohm resistor is required.

### Electrical Specifications, $T_A = +25^\circ\text{C}$ , $V_{CC} = +3\text{V to } +5\text{V}$

| Parameter  | Frequency     | Min.                               | Typical | Max. | Units |
|--|---------------|------------------------------------|---------|------|-------|
| Insertion Loss   | 0.7 - 1.4 GHz |                                    | 1.9     | 2.4  | dB    |
|  | 1.4 - 2.3 GHz |                                    | 2.3     | 2.8  | dB    |
|  | 2.3 - 2.7 GHz |                                    | 2.6     | 3.1  | dB    |
|  | 2.7 - 3.7 GHz |                                    | 2.8     | 3.3  | dB    |
| Attenuation Range  | 0.7 - 3.7 GHz |                                    | 31      |      | dB    |
| Return Loss (RF1 & RF2, All Atten. States)                                     | 0.7 - 1.4 GHz |                                    | 12      |      | dB    |
|  | 1.4 - 2.7 GHz |                                    | 15      |      | dB    |
|  | 2.7 - 3.7 GHz |                                    | 16      |      | dB    |
| Attenuation Accuracy: (Referenced to Insertion Loss)<br>All Attenuation States | 0.7 - 0.9 GHz | ± (0.4 + 5% of Atten. Setting) Max |         |      | dB    |
|  | 0.9 - 2.2 GHz | ± (0.4 + 4% of Atten. Setting) Max |         |      | dB    |
|  | 2.2 - 3.7 GHz | ± (0.4 + 5% of Atten. Setting) Max |         |      | dB    |
| Input Power for 0.1 dB Compression<br><div>Vcc = 5V<br/>Vcc = 3V</div>         | 0.7 - 3.7 GHz |                                    | 24      |      | dBm   |
|  |               |                                    | 22      |      | dBm   |
| Input Third Order Intercept Point<br>(Two-tone Input Power = 0 dBm Each Tone)  | 0.7 - 3.7 GHz |                                    | 48      |      | dBm   |
|  |               |                                    | 46      |      | dBm   |
| Switching Characteristics  |               |                                    |         |      |       |
| tRISE, tFALL (10/90% RF)   | 0.7 - 3.7 GHz |                                    | 750     |      | ns    |
| tON, tOFF (Latch Enable to 10/90% RF)  |               |                                    | 830     |      | ns    |

For price, delivery, and to place orders, please contact Hittite Microwave Corporation:  
 20 Alpha Road, Chelmsford, MA 01824 Phone: 978-250-3343 Fax: 978-250-3373  
 Order On-line at [www.hittite.com](http://www.hittite.com)



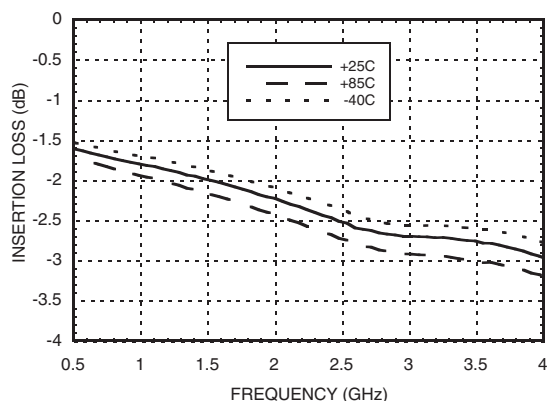
v03.0809



## HMC271LP4 / 271LP4E

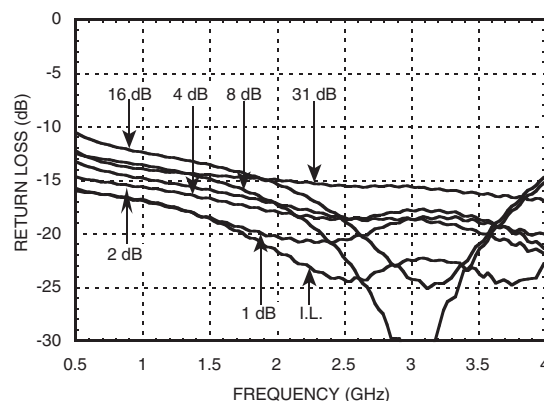
### 1 dB LSB GaAs MMIC 5-BIT SERIAL CONTROL DIGITAL ATTENUATOR, 0.7 - 3.7 GHz

#### Insertion Loss



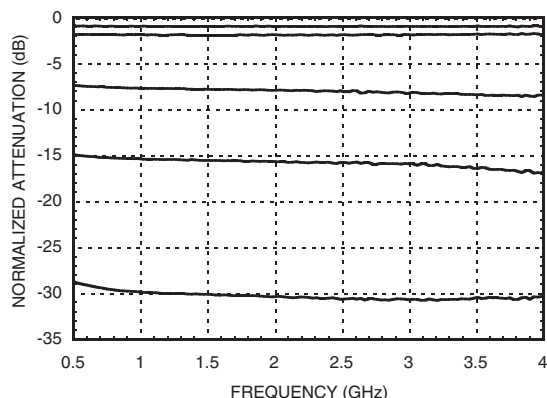
#### Return Loss RF1, RF2

(Only Major States are Shown)



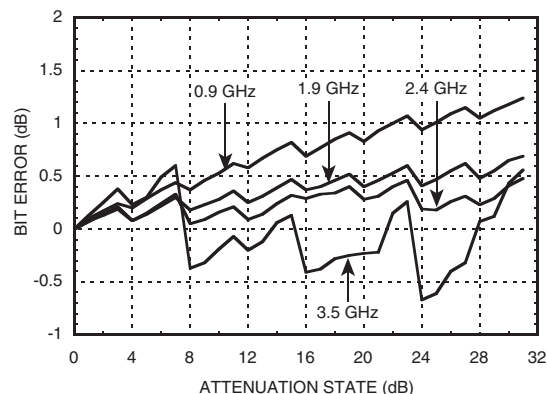
#### Normalized Attenuation

(Only Major States are Shown)



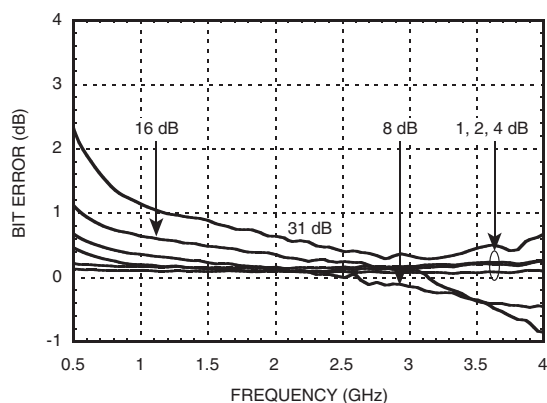
#### Bit Error

vs. Attenuation State



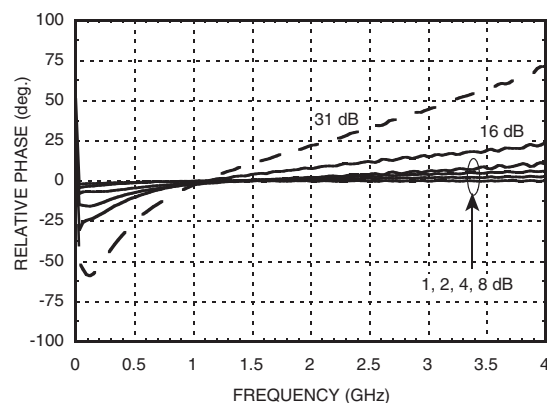
#### Bit Error vs. Frequency

(Only Major States are Shown)



#### Relative Phase vs. Frequency

(Only Major States are Shown)



Note: All Data Typical Over Voltage (+3V to +5V) & Temperature (-40 to +85 deg. C.).

For price, delivery, and to place orders, please contact Hittite Microwave Corporation:  
20 Alpha Road, Chelmsford, MA 01824 Phone: 978-250-3343 Fax: 978-250-3373  
Order On-line at [www.hittite.com](http://www.hittite.com)

[查询"HMC271LP4\\_09"供应商](#)

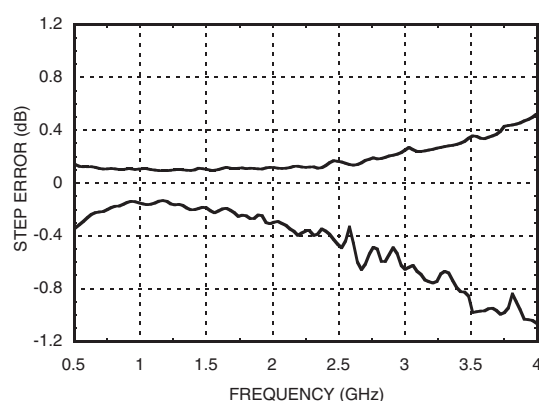

v03.0809



## HMC271LP4 / 271LP4E

**1 dB LSB GaAs MMIC 5-BIT SERIAL  
CONTROL DIGITAL ATTENUATOR, 0.7 - 3.7 GHz**

### Worst Case Step Error Between Successive Attenuation States



### Digital Control Voltages

| State | Vcc = +5V | Vcc = +3V |
|-------|-----------|-----------|
| Low   | 0 to 1.3V | 0 to 0.7V |
| High  | 3.5 to 5V | 2.3 to 3V |

### Serial Input Truth Table

| Latch Enable | Shift Clock | Reset | Function   |
|--------------|-------------|-------|--|
| X            | X           | L     | Shift register cleared                                       |
| X            | ↑           | H     | Shift register clocked                                       |
| ↑            | X           | H     | Contents of shift register transferred to Digital Attenuator |

### Timing

| Parameter   | Symbol | Vcc = +5V |      | Vcc = +3V |      | Units |
|---|--------|-----------|------|-----------|------|-------|
|   |        | Min.      | Max. | Min.      | Max. |       |
| Serial Input Setup Time                           | ts     | 20        | -    | 100       | -    | ns    |
| Hold time from Serial Input to Shift Clock        | th     | 0         | -    | 5         | -    | ns    |
| Setup time from Shift Clock to Latch Enable       | tlslup | 40        | -    | 100       | -    | ns    |
| Propagation delay, Latch Enable to C1 through C16 | tpd    | -         | 30   | -         | 70   | ns    |
| Setup time from Reset to Shift Clock              | -      | 20        | -    | 50        | -    | ns    |
| Clock Frequency (1/tclk)                          | fclk   | -         | 30   | -         | 10   | MHz   |

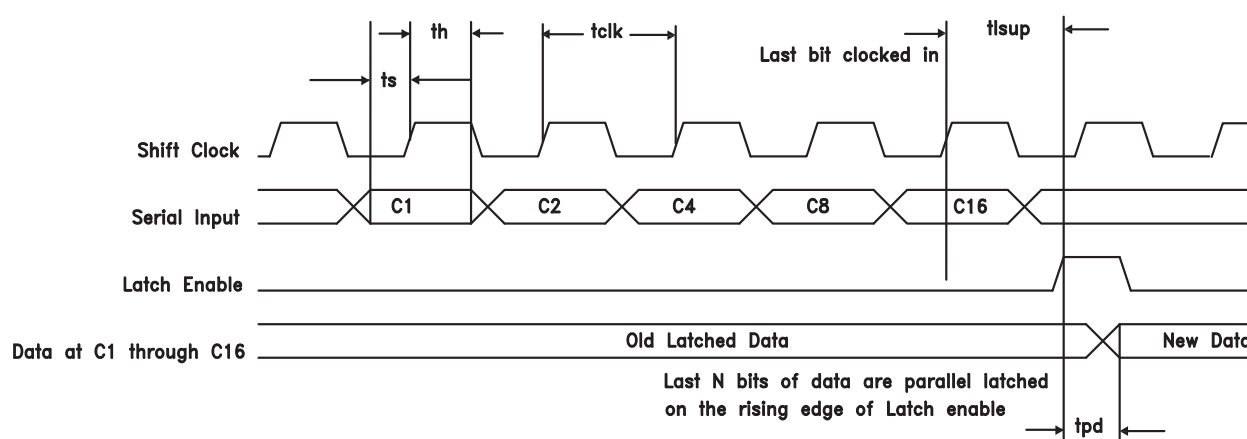
### Truth Table

| Serial Data Input |      |      |      |      | Attenuation Setting<br>RF1 - RF2 |
|-------------------|------|------|------|------|----------------------------------|
| C1                | C2   | C4   | C8   | C16  |                                  |
| High              | High | High | High | High | Reference I.L.                   |
| Low               | High | High | High | High | 1 dB                             |
| High              | Low  | High | High | High | 2 dB                             |
| High              | High | Low  | High | High | 4 dB                             |
| High              | High | High | Low  | High | 8 dB                             |
| High              | High | High | High | Low  | 16 dB                            |
| Low               | Low  | Low  | Low  | Low  | 31 dB Max. Atten.                |

Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

### Timing Diagram

Serial data is shifted in on the rising edge of the Shift Clock, LSB first, and is latched on the rising edge of Latch Enable.



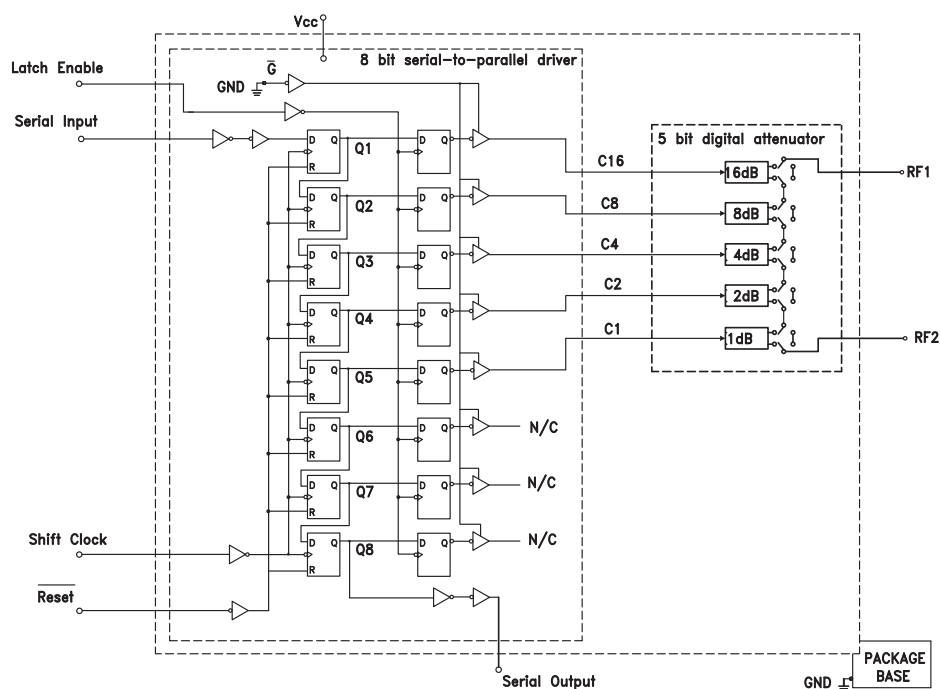
For price, delivery, and to place orders, please contact Hittite Microwave Corporation:  
20 Alpha Road, Chelmsford, MA 01824 Phone: 978-250-3343 Fax: 978-250-3373  
Order On-line at [www.hittite.com](http://www.hittite.com)



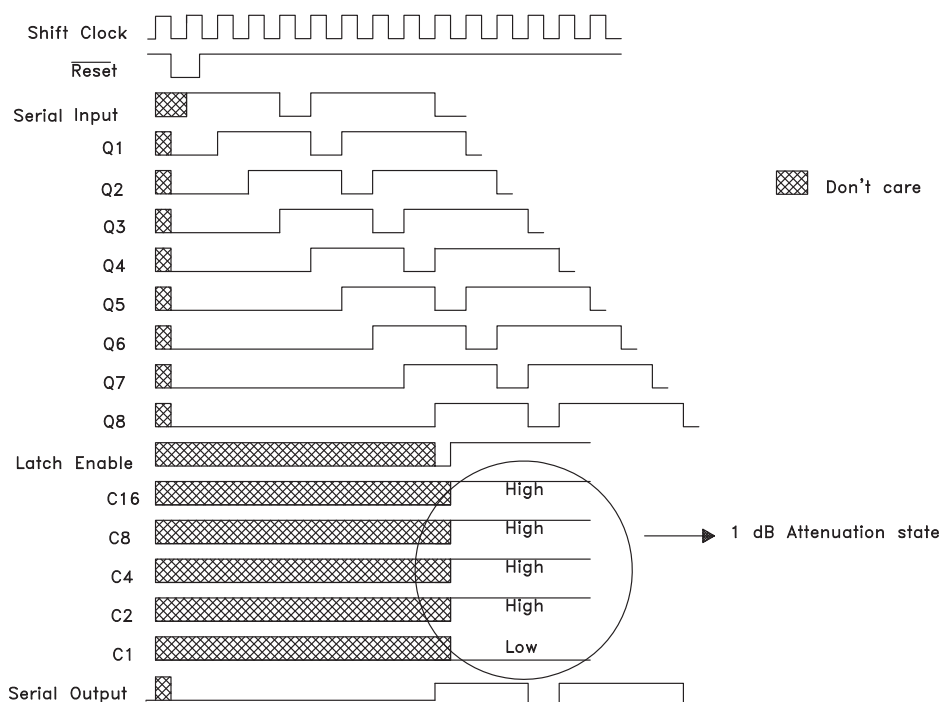
## HMC271LP4 / 271LP4E

**1 dB LSB GaAs MMIC 5-BIT SERIAL  
CONTROL DIGITAL ATTENUATOR, 0.7 - 3.7 GHz**

### Logic / Functional Diagram



### Programming Example to Select 1 dB Attenuation State



[查询"HMC271LP4\\_09"供应商](#)


v03.0809

# HMC271LP4 / 271LP4E

**1 dB LSB GaAs MMIC 5-BIT SERIAL  
CONTROL DIGITAL ATTENUATOR, 0.7 - 3.7 GHz**

## Pin Descriptions

| Pin Number                         | Function      | Description   | Interface Schematic |
|------------------------------------|---------------|---|---------------------|
| 1, 3, 4, 6, 10, 12, 13, 15, 16, 18 | N/C           | These pins should be connected to PCB RF ground to maximize performance.  |                     |
| 2, 17                              | RF1, RF2      | This pin is DC coupled and matched to 50 Ohms. Blocking capacitors are required. Select value based on lowest frequency of operation. |                     |
| 5                                  | Serial Output | Serial data output. Serial input data delayed by 8 clock cycles.  |                     |
| 7                                  | Reset         | See truth table, control voltage table and timing diagram.  |                     |
| 8                                  | Shift Clock   |   |                     |
| 9                                  | Latch Enable  |   |                     |
| 11                                 | Serial Input  |   |                     |
| 14                                 | Vcc           | Supply Voltage.   |                     |
| 19 - 24                            | GND           | Package bottom has an exposed metal paddle that must also be connected to RF/DC Ground.   |                     |

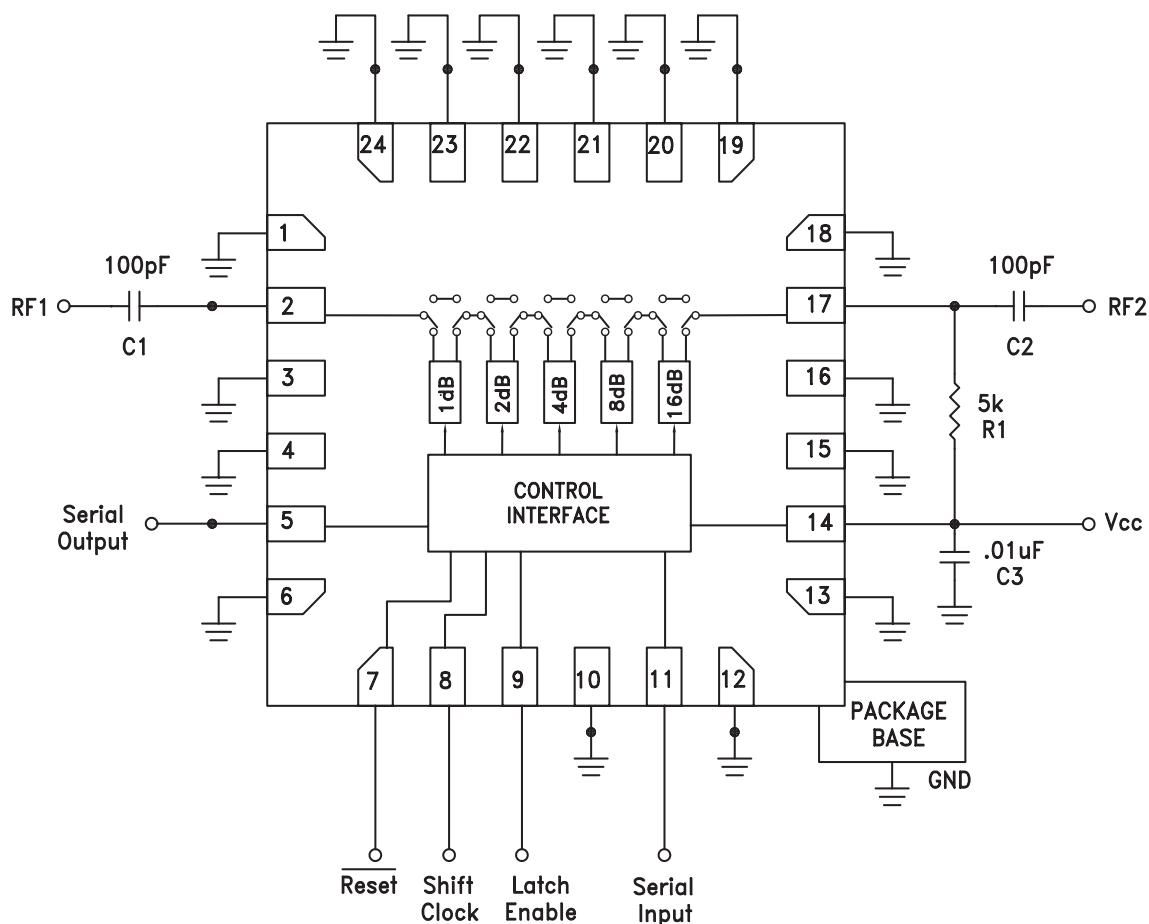


v03.0809

## HMC271LP4 / 271LP4E

**1 dB LSB GaAs MMIC 5-BIT SERIAL  
CONTROL DIGITAL ATTENUATOR, 0.7 - 3.7 GHz**

### Application Circuit



DC blocking capacitors C1 & C2 are required on RF1 & RF2. Choose  $C1 = C2 = 100 \sim 300 \text{ pF}$  to allow lowest customer specific frequency to pass with minimal loss.  $R1 = 5k \text{ Ohm}$  is required to supply voltage to the circuit through either PIN 2 or PIN 17.

[查询"HMC271LP4\\_09"供应商](#)


v03.0809

## HMC271LP4 / 271LP4E

**1 dB LSB GaAs MMIC 5-BIT SERIAL  
CONTROL DIGITAL ATTENUATOR, 0.7 - 3.7 GHz**

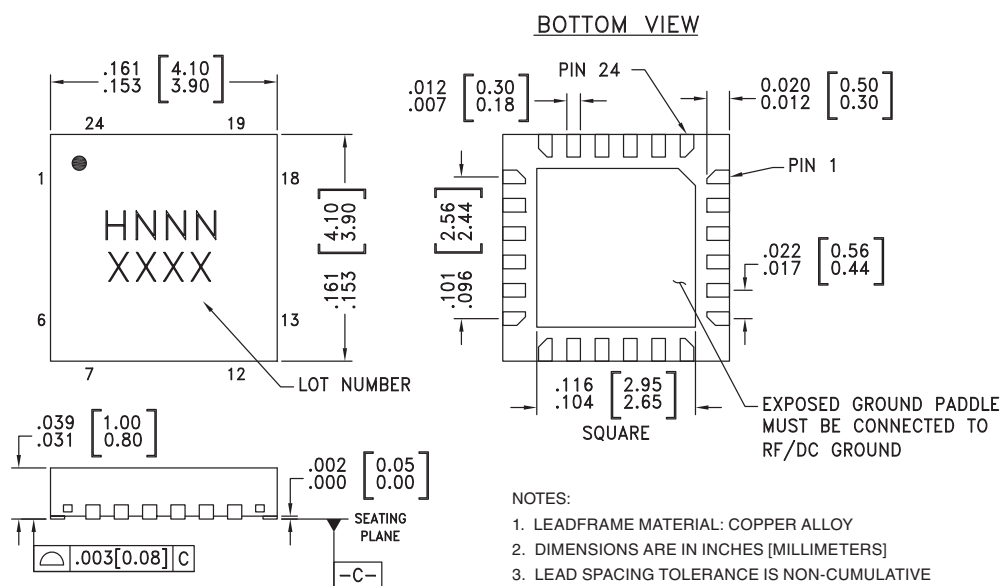
### Absolute Maximum Ratings

|  |                       |
|--|-----------------------|
| Digital Inputs (Reset, Shift Clock, Latch Enable & Serial Input) | -1.5 to (Vcc + 1.5) V |
| Digital Outputs (Serial Output)                                  | -0.5 to (Vcc + 0.5) V |
| DC Current on Serial Output                                      | ±35 mA                |
| Bias Voltage (Vcc)   | +7V                   |
| Storage Temperature  | -65 to +150 °C        |
| Operating Temperature  | -40 to +85 °C         |
| RF Input Power (0.7 - 3.7 GHz)                                   | +26 dBm               |
| ESD Sensitivity (HBM)  | Class 1A              |



**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 HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.

### Package Information

| Part Number | Package Body Material                              | Lead Finish   | MSL Rating          | Package Marking <sup>[3]</sup> |
|-------------|--|---------------|---------------------|--------------------------------|
| HMC271LP4   | Low Stress Injection Molded Plastic                | Sn/Pb Solder  | MSL1 <sup>[1]</sup> | H271<br>XXXX                   |
| HMC271LP4E  | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 <sup>[2]</sup> | H271<br>XXXX                   |

[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX

For price, delivery, and to place orders, please contact Hittite Microwave Corporation:  
20 Alpha Road, Chelmsford, MA 01824 Phone: 978-250-3343 Fax: 978-250-3373  
Order On-line at [www.hittite.com](http://www.hittite.com)



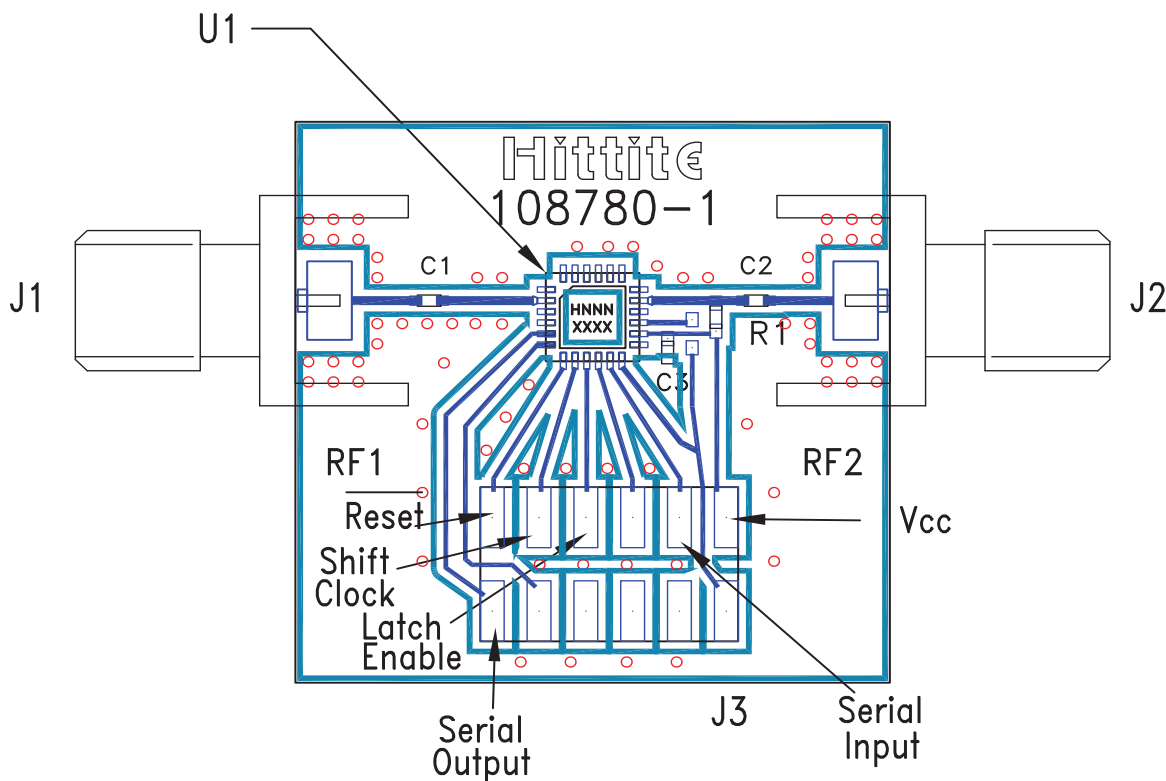
v03.0809



## HMC271LP4 / 271LP4E

**1 dB LSB GaAs MMIC 5-BIT SERIAL  
CONTROL DIGITAL ATTENUATOR, 0.7 - 3.7 GHz**

### Evaluation Circuit Board



### List of Materials for Evaluation PCB 108782 <sup>[1]</sup>

| Item               | Description                               |
|--------------------|---|
| J1 - J2            | PCB Mount SMA Connector                   |
| J3                 | 2 mm Molex Header                         |
| C1, C2             | 100 pF Capacitor, 0402 Pkg.               |
| C3                 | 0.01 $\mu$ F Capacitor, 0402 Pkg.         |
| R1                 | 5k Ohm Resistor, 0402 Pkg.                |
| U1                 | HMC271LP4 / HMC271LP4E Digital Attenuator |
| PCB <sup>[2]</sup> | 108780 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 exposed ground paddle should be connected directly to the ground plane similar to that shown below. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation circuit board as shown is available from Hittite Microwave Corporation upon request.



**This datasheet has been downloaded from:**

**[www.EEworld.com.cn](http://www.EEworld.com.cn)**

**Free Download**

**Daily Updated Database**

**100% Free Datasheet Search Site**

**100% Free IC Replacement Search Site**

**Convenient Electronic Dictionary**

**Fast Search System**

**[www.EEworld.com.cn](http://www.EEworld.com.cn)**