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HMC801LP3ETR

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ANALOG DEVICES

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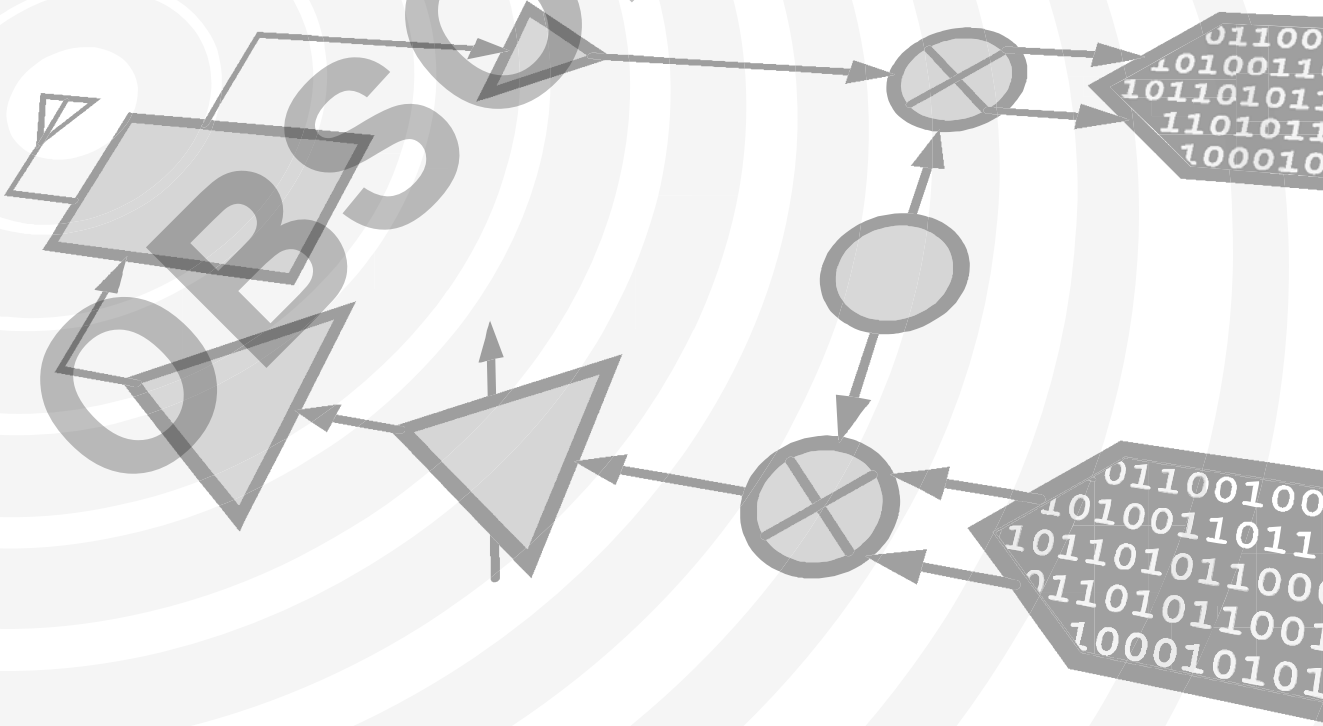
# Analog Devices Welcomes Hittite Microwave Corporation

**NO CONTENT ON THE ATTACHED DOCUMENT HAS CHANGED**





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# HMC801LP3E

v01.0610

## 15 dB GaAs MMIC 1-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 10 GHz

### Typical Applications

The HMC801LP3E is ideal for both RF and IF applications:

- Test Equipment and Sensors
- ISM, MMDS, WLAN, WiMAX, WiBro
- Microwave Radio & VSAT
- Cellular Infrastructure

### Features

± 0.4 dB Typical Step Error

Low Insertion Loss: 2 dB

High IP3: +53 dBm

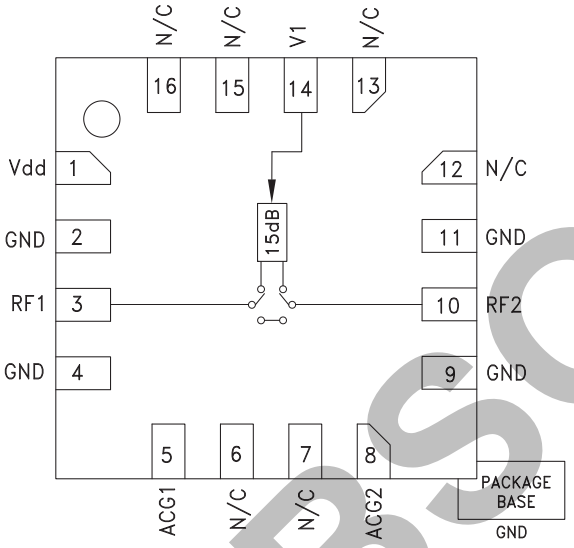
Single Control Line

TTL/CMOS Compatible Control

Single +5V Supply

16 Lead 3x3 mm SMT Package: 9 mm²

### Functional Diagram




### General Description

The HMC801LP3E is a broadband bidirectional 1-bit GaAs IC digital attenuator in a low cost leadless surface mount package. This single positive control line digital attenuator utilizes off chip AC ground capacitors for near DC operation, making it suitable for a wide variety of RF and IF applications. Covering DC to 10 GHz, the insertion loss is less than 2 dB typical and attenuation accuracy is excellent at ±0.4 dB typical step error. The attenuator also features a high IIP3 of +53 dBm. One TTL/CMOS control input is used to select the attenuation state and a single Vdd bias of +5V is required.



### Electrical Specifications, $T_A$ = +25° C, With Vdd = +5V & Vctl = 0/+5V

| Parameter | Frequency (GHz) | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Insertion Loss | DC - 4 GHz<br>4 - 8 GHz<br>8 - 10 GHz | | 1.0<br>2.0<br>2.5 | 2.0<br>3.0<br>3.5 | dB<br>dB<br>dB |
| Attenuation Range | DC - 10 GHz | | 15 | | dB |
| Return Loss (RF1 & RF2, Both States) | DC - 6 GHz<br>6 - 10 GHz | | 18<br>14 | | dB<br>dB |
| Attenuation Accuracy: (Referenced to Insertion Loss) | DC - 8 GHz<br>8 - 10 GHz | | ± 0.4<br>± 0.5 | ± 0.6<br>± 0.7 | dB<br>dB |
| Input Power for 0.1 dB Compression | DC - 0.4 GHz<br>0.4 - 10 GHz | | 20<br>30* | | dBm<br>dBm |
| Input Third Order Intercept Point<br>(Two-Tone Input Power= 0 dBm Each Tone) | DC - 0.4 GHz<br>0.4 - 10 GHz | | 43<br>53 | | dBm |
| Switching Characteristics<br>tRISE, tFALL (10/90% RF)<br>tON, tOFF (50% CTL to 10/90% RF) | DC - 10 GHz | | <br>120<br>150 | | <br>ns<br>ns |

* For frequencies greater than 0.4 GHz, the 0.1 dB compression point is greater than the absolute maximum RF input power of 30 dBm.

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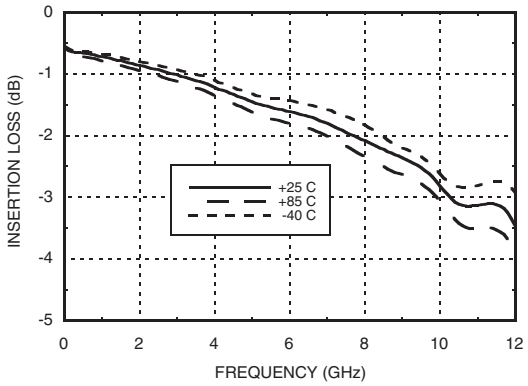
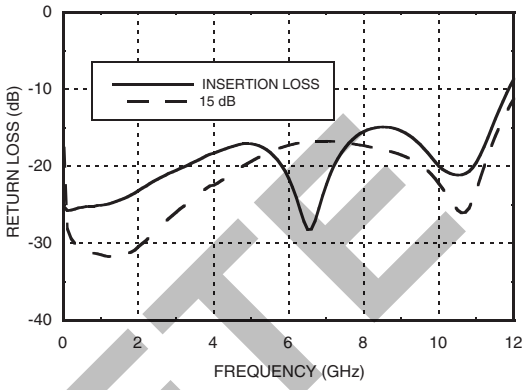
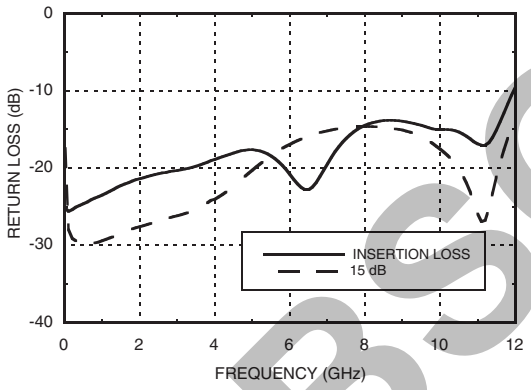
### Insertion Loss



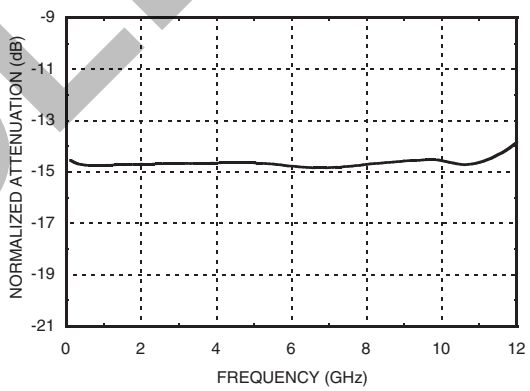

### Input Return Loss



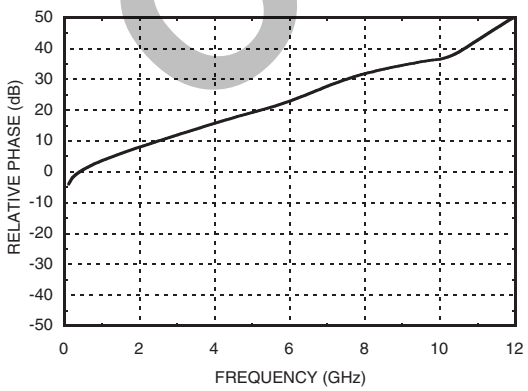

### Output Return Loss



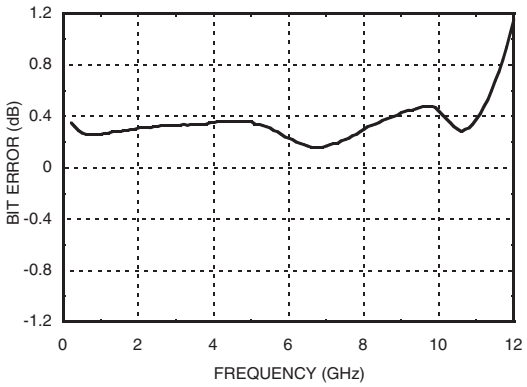

### Relative Attenuation




### Relative Phase vs. Frequency




### Bit Error vs. Frequency



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# HMC801LP3E

## 15 dB GaAs MMIC 1-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 10 GHz

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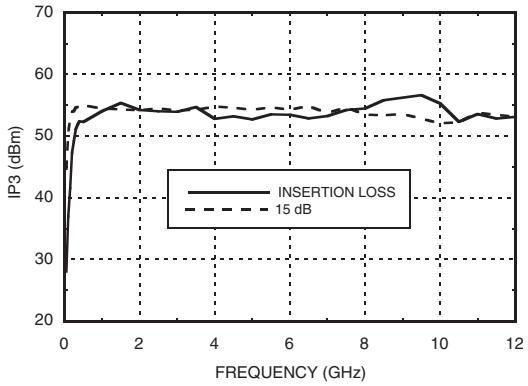
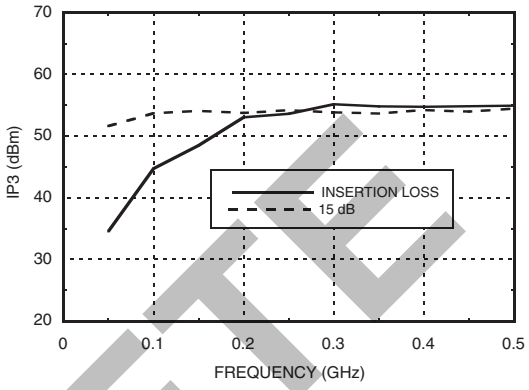
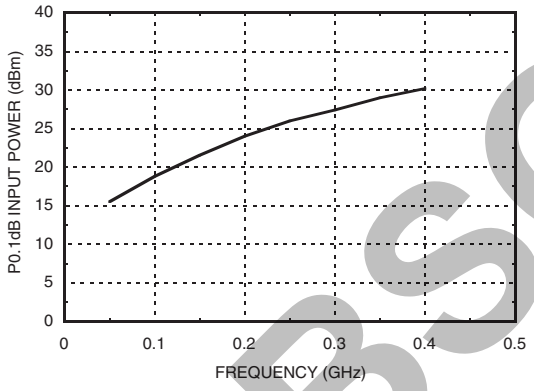
### Input IP3 vs. Frequency




### Input IP3 vs. Frequency
*(Low Frequency Detail)*




### Input Power for 0.1 dB Compression*
*(Low Frequency Detail)*




### Truth Table

| Control Voltage Input V1 | Attenuation State RF1 - RF2 |
|---|---|
| High | Reference Insertion Loss |
| Low | 15 dB |

### Bias Voltage & Current

| Vdd = +5 Vdc ± 10% | |
|---|---|
| Vdd (Vdc) | Idd (Typ.) (mA) |
| 4.5 | 0.21 |
| 5.0 | 0.23 |
| 5.5 | 0.25 |

### Control Voltage

| State | Bias Condition |
|---|---|
| Low | 0 to +0.8V @ -1 µA Typ. |
| High | +2 to +5V @ 30 µA Typ. |
| Note: Vdd = +5V | |



* For frequencies greater than 0.4 GHz, the 0.1 dB compression point is greater than the absolute maximum RF input power of 30 dBm.

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# HMC801LP3E

## 15 dB GaAs MMIC 1-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 10 GHz

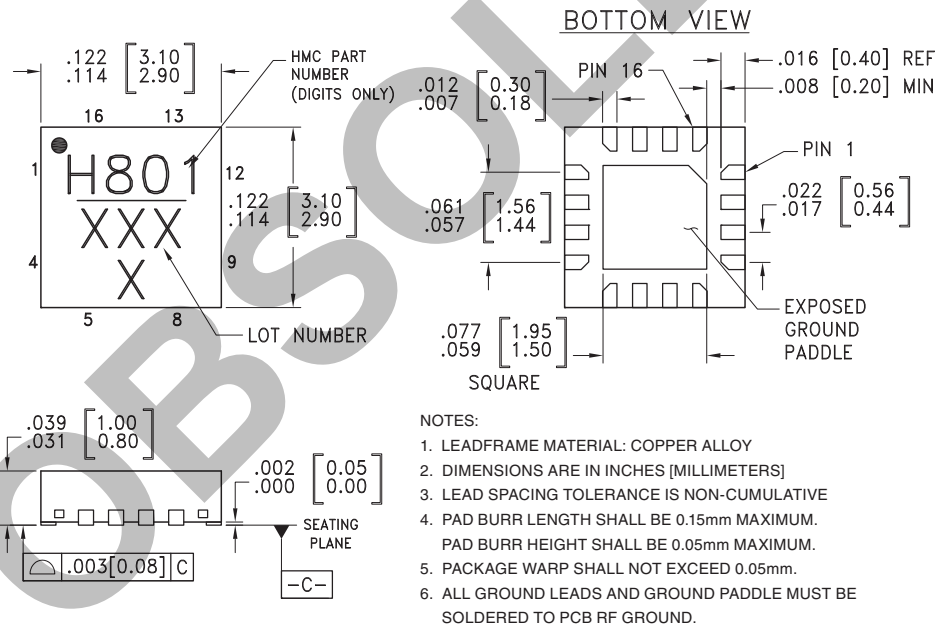
### Absolute Maximum Ratings

| | |
|---|---|
| RF Input Power (DC - 10 GHz) | +30 dBm |
| Control Voltage Range (V1) | -1 to Vdd +1V |
| Bias Voltage (Vdd) | +7 Vdc |
| Channel Temperature | 150 °C |
| Continuous Pdiss (T = 85 °C) (derate 12 mW/°C above 85 °C) | 0.783 W |
| Thermal Resistance (channel to ground paddle) | 83 °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




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 [2] |
|---|---|---|---|---|
| HMC801LP3E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 [1] | H801<br>XXXX |

[1] Max peak reflow temperature of 260 °C
[2] 4-Digit lot number XXXX

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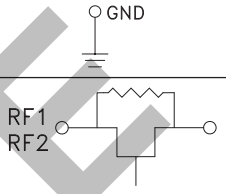
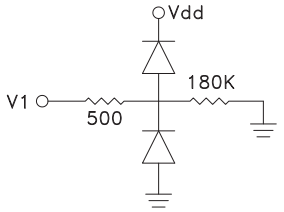
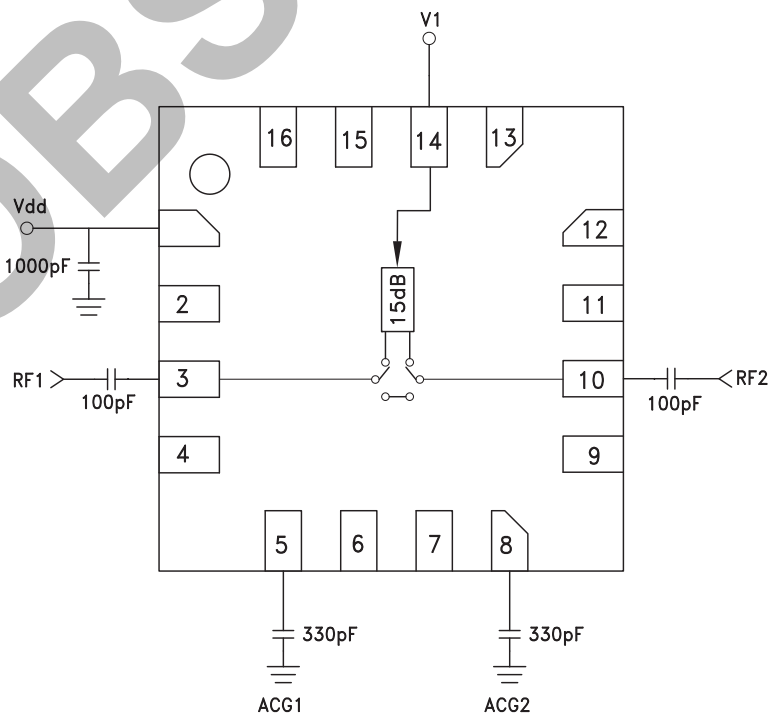
# HMC801LP3E

## 15 dB GaAs MMIC 1-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 10 GHz

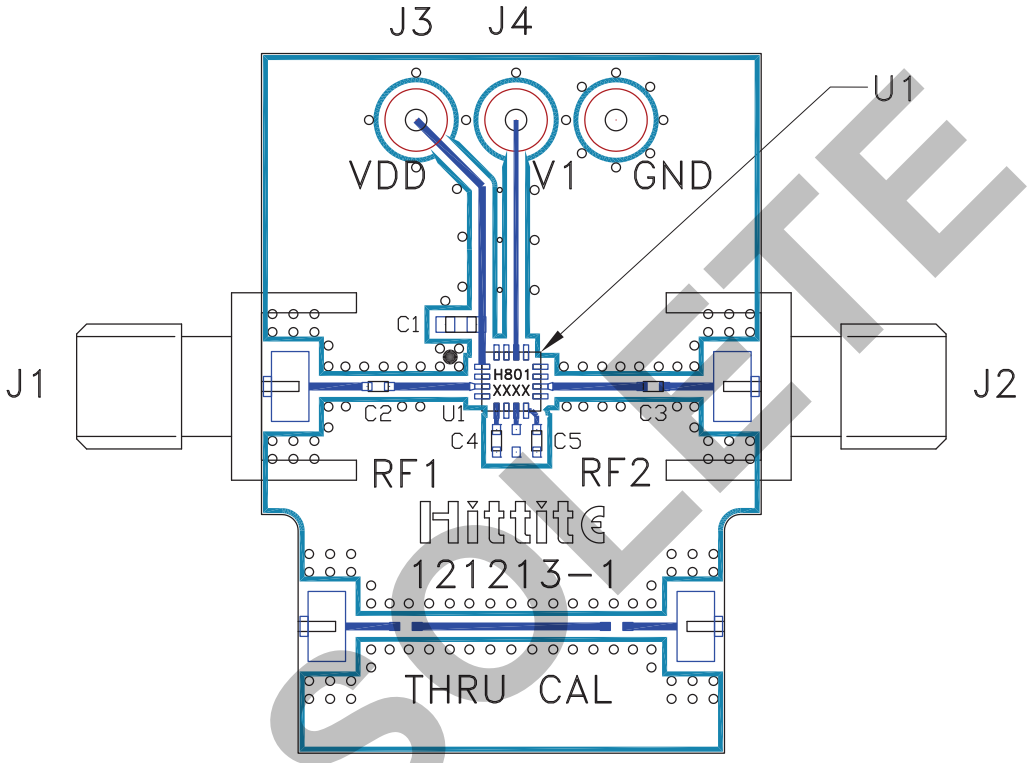
### Pin Descriptions

| Pin Number | Function | Description | Interface Schematic |
|---|---|---|---|
| 1 | Vdd | Supply Voltage. | |
| 2, 4, 9, 11 | GND | These pins and the exposed ground paddle must be connected to RF/DC ground. |   |
| 3, 10 | RF1, RF2 | These pins are DC coupled and matched to 50 Ohms. Blocking capacitors are required. Select value based on lowest frequency of operation. |   |
| 5, 8 | ACG1, ACG2 | External capacitor to ground is required. Select value for lowest frequency of operation. Place capacitor as close to pins as possible. | |
| 6, 7, 12, 13, 15, 16 | N/C | The pins are not connected internally; however, all data shown herein was measured with these pins connected to RF/DC ground externally. | |
| 14 | V1 | See truth table and control voltage table. |   |

### Application Circuit



## Evaluation PCB






## List of Materials for Evaluation PCB 126894 [1]

| Item | Description |
|---|---|
| J1, J2 | PCB Mount SMA Connector |
| J3, J4 | DC Connector |
| C1 | 1000 pF Capacitor, 0603 Pkg. |
| C2, C3 | 100 pF Capacitor, 0402 Pkg. |
| C4, C5 | 330 pF Capacitor, 0402 Pkg. |
| U1 | HMC801LP3E Digital Attenuator |
| PCB [2] | 121213 Evaluation PCB |

[1] Reference this number when ordering complete evaluation PCB

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

The circuit board used in the 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.