

1 dB LSB GaAs MMIC 5-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 3 GHz

Typical Applications

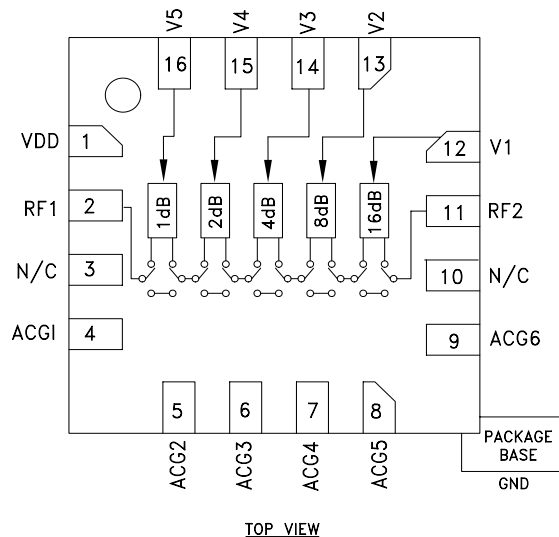
The HMC470ALP3E is ideal for:

- Cellular/Wireless Infrastructure
- Microwave Radio & VSAT
- Test Equipment and Sensors

Features

- 1 dB LSB Steps to 31 dB
- Single Control Line Per Bit
- TTL/CMOS Compatible Control
- ± 0.3 dB Typical Step Error
- Single +5V Supply
- 16 Lead 3x3mm SMT Package: 9mm²

Functional Diagram



General Description

The HMC470ALP3E is a broadband 5-bit GaAs IC digital attenuators in low cost leadless surface mount packages. This single positive control line per bit digital attenuator incorporates off chip AC ground capacitors for near DC operation, making it suitable for a wide variety of RF and IF applications. Covering DC to 3 GHz, the insertion loss is less than 1.5 dB typical. The attenuator bit values are 1 (LSB), 2, 4, 8, and 16 dB for a total attenuation of 31 dB. Attenuation accuracy is excellent at ± 0.3 dB typical step error with an IIP3 of +49 dBm. Five TTL/CMOS control inputs are used to select each attenuation state. A single Vdd bias of +5V is required.

Electrical Specifications,

$T_A = +25^\circ\text{C}$, With $V_{dd} = +5\text{V}$ & $V_{ctl} = 0/+5\text{V}$ (Unless Otherwise Noted)

| Parameter | Frequency (GHz) | Min. | Typ. | Max. | Units |
|---|-----------------|-------------------------------------|------|------|-------|
| Insertion Loss | DC - 1.5 GHz | | 1.3 | 1.6 | dB |
| | 1.5 - 2.3 GHz | | 1.5 | 1.8 | dB |
| | 2.3 - 3.0 GHz | | 1.7 | 2.0 | dB |
| Attenuation Range | DC - 3 GHz | | 31 | | dB |
| Return Loss (RF1 & RF2, All Atten. States) | DC - 3 GHz | | 14 | | dB |
| Attenuation Accuracy: (Referenced to Insertion Loss) All Attenuation States 1.0 - 15.0 dB States 16.0 - 31.0 dB States | DC - 2.3 GHz | ± (0.3 + 2% of Atten. Setting) Max. | | | dB |
| | 2.3 - 3.0 GHz | ± (0.3 + 3% of Atten. Setting) Max. | | | dB |
| | 2.3 - 3.0 GHz | ± (0.3 + 6% of Atten. Setting) Max. | | | dB |
| Input Power for 0.1 dB Compression | 0.1 - 3.0 GHz | | 27 | | dBm |
| Input Third Order Intercept Point (Two-Tone Input Power= 10 dBm Each Tone) | 0.1 - 3.0 GHz | REF-15dB States | 49 | | dBm |
| | | 16 - 31dB States | 48 | | dBm |
| Switching Characteristics | DC - 3 GHz | tRISE, tFALL (10/90% RF) | 50 | | ns |
| | | tON, tOFF (50% CTL to 10/90% RF) | 70 | | ns |
| | | | | | |

HMC470A* PRODUCT PAGE QUICK LINKS

Last Content Update: 02/23/2017

COMPARABLE PARTS

View a parametric search of comparable parts.

EVALUATION KITS

- HMC470A Evaluation Board

DOCUMENTATION

Data Sheet

- HMC470ALP3E: 1 dB LSB GaAs MMIC 5-Bit Digital Positive Control Attenuator, DC - 3 GHz Data Sheet

DESIGN RESOURCES

- HMC470A Material Declaration
- PCN-PDN Information
- Quality And Reliability
- Symbols and Footprints

DISCUSSIONS

View all HMC470A EngineerZone Discussions.

SAMPLE AND BUY

Visit the product page to see pricing options.

TECHNICAL SUPPORT

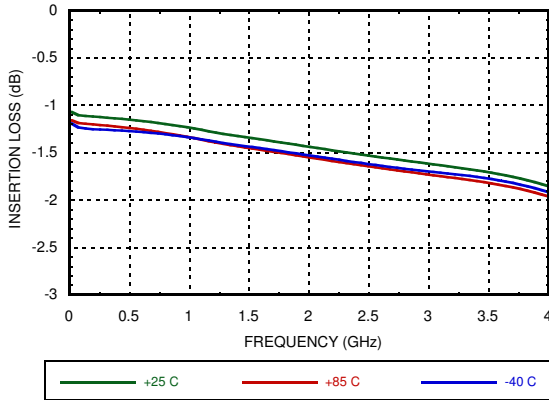
Submit a technical question or find your regional support number.

DOCUMENT FEEDBACK

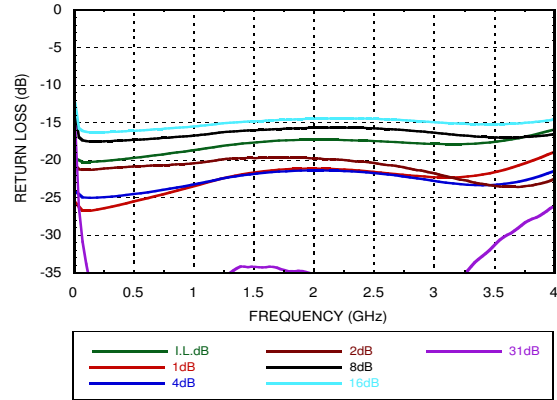
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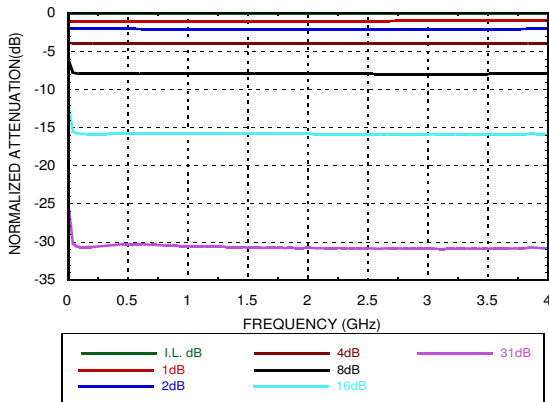
Insertion Loss



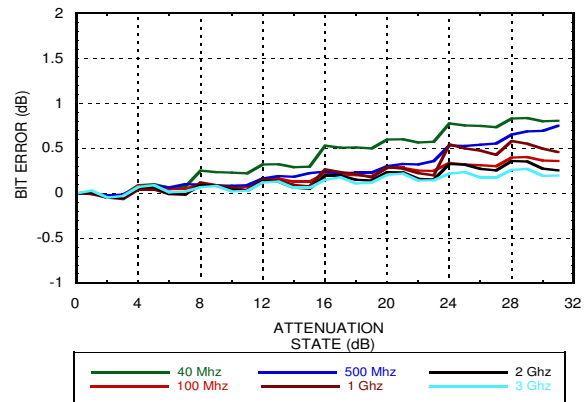
Return Loss RF1, RF2
(Only Major States are Shown)



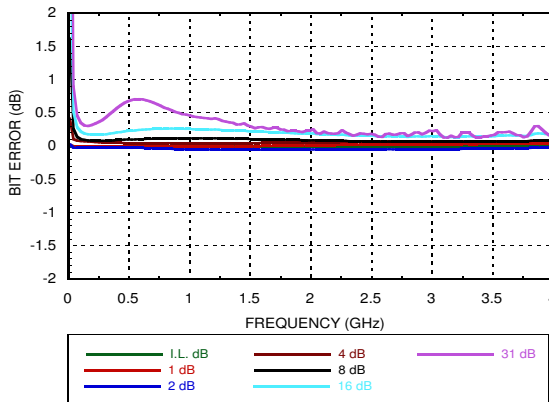
Normalized Attenuation
(Only Major States are Shown)



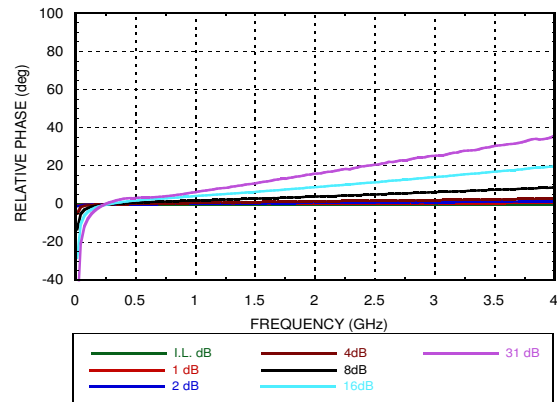
Bit Error vs. Attenuation State



Bit Error vs. Frequency
(Only Major States are Shown)

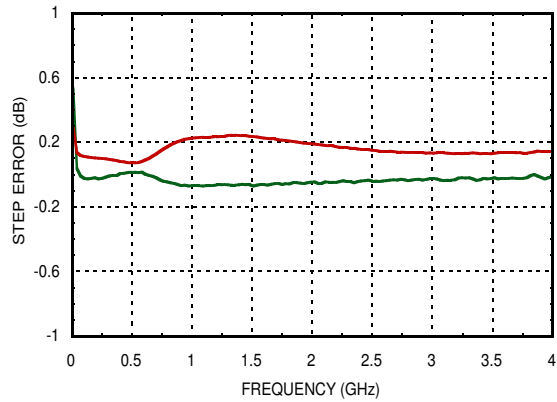


Relative Phase vs. Frequency
(Only Major States are Shown)



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Worst Case Step Error Between Successive Attenuation States



Bias Voltage & Current

| Vdd = +5V ± 10% | |
|-----------------|-----------------|
| Vdd (V) | Idd (Typ.) (mA) |
| +4.5 | 1.6 |
| +5.0 | 1.7 |
| +5.5 | 1.8 |

Control Voltage

| State | Bias Condition |
|-------|-----------------------------|
| Low | 0 to +0.8V @ 1 uA Typ. |
| High | +2.0 to +5 Vdc @ 40 uA Typ. |

Note: Vdd = +5V

Truth Table

| Control Voltage Input | | | | | Attenuation State RF1 - RF2 |
|-----------------------|------------|------------|------------|------------|--------------------------------|
| V1 16 dB | V2 8 dB | V3 4 dB | V4 2 dB | V5 1 dB | |
| High | High | High | High | High | Reference I.L. |
| High | High | High | High | Low | 1 dB |
| High | High | High | Low | High | 2 dB |
| High | High | Low | High | High | 4 dB |
| High | Low | High | High | High | 8 dB |
| Low | High | High | High | High | 16 dB |
| Low | Low | Low | Low | Low | 31 dB |

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

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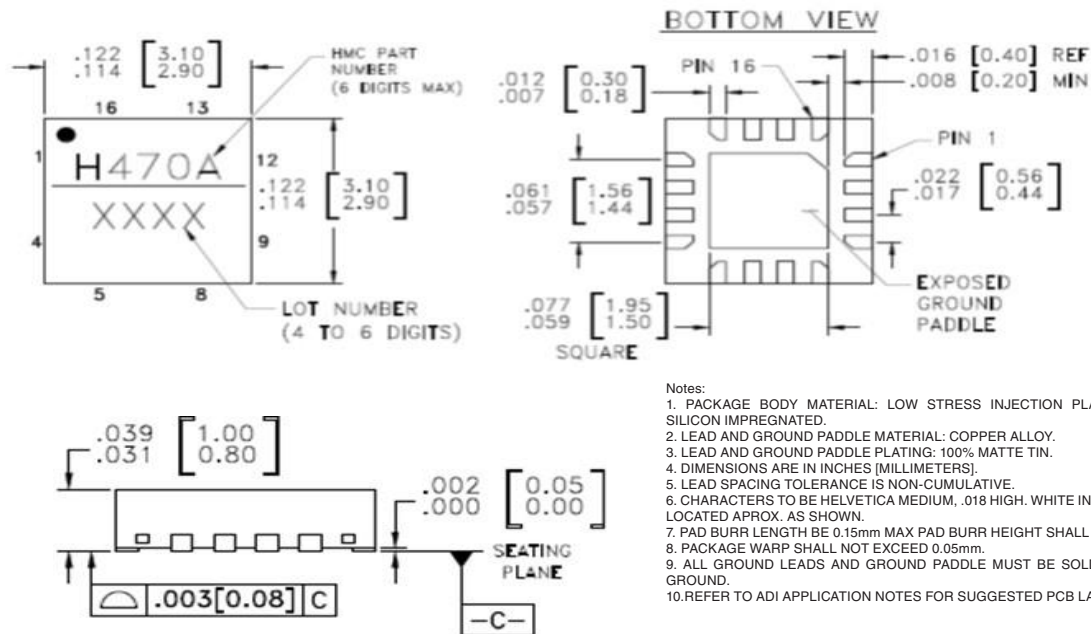
Absolute Maximum Ratings

| | |
|--|----------------------|
| RF Input Power (DC - 3 GHz) | +27 dBm (T = +85 °C) |
| Control Voltage Range (V1 to V5) | -1V to Vdd +1V |
| Bias Voltage (Vdd) | +7V |
| Channel Temperature | 150 °C |
| Continuous P _{diss} (T = 85 °C) (derate 7.7 mW/°C above 85 °C) | 0.5 W |
| Thermal Resistance | 130 °C/W |
| Storage Temperature | -65 to +150°C |
| Operating Temperature | -40 to +85°C |
| ESD | Class 1A |



ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[2] |
|-------------|--|---------------|---------------------|--------------------------------|
| HMC470ALP3E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL3 ^[1] | H470A XXXX |

[1] Max peak reflow temperature of 260 C.

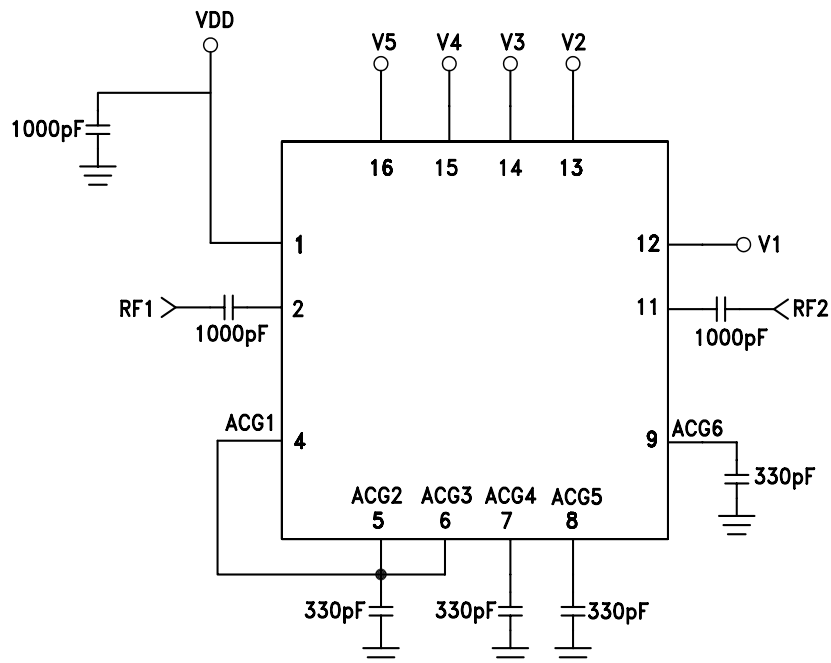
[2] 4- Digit lot number XXXX.

1 dB LSB GaAS MMIC 5-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 3 GHz

Pin Descriptions

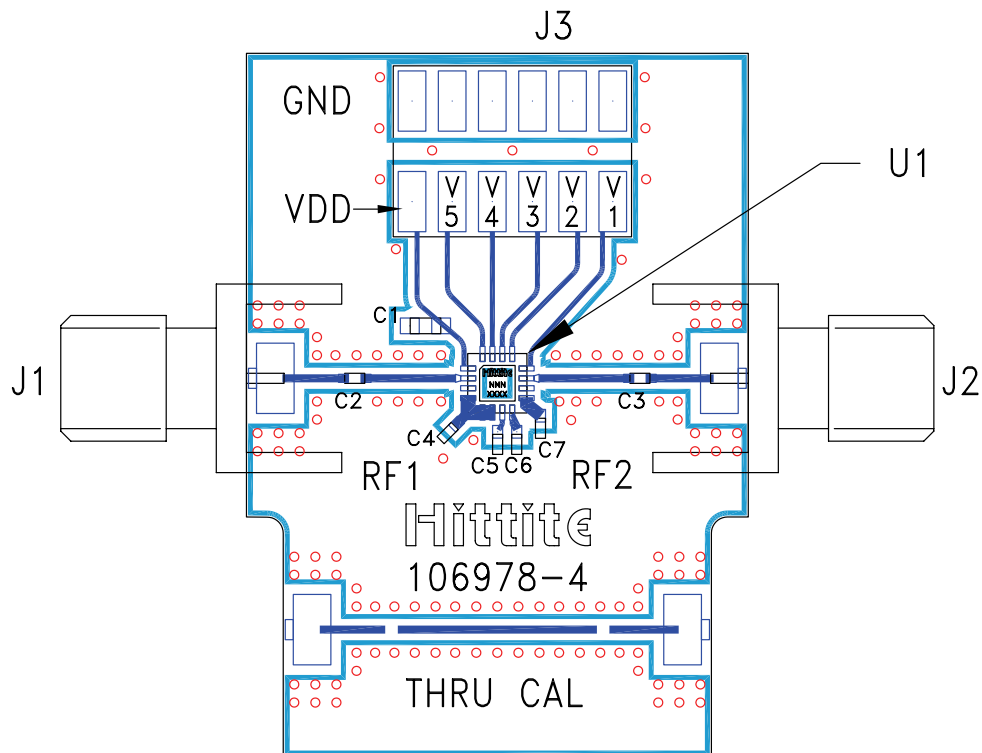
| Pin Number | Function | Description | Interface Schematic |
|------------|-------------|---|---------------------|
| 1 | Vdd | Supply Voltage. | |
| 2, 11 | RF1, RF2 | This pin is DC coupled and matched to 50 Ohm. Blocking capacitors are required. Select value based on lowest frequency of operation. | |
| 3, 10 | N/C | These pins should be connected to PCB RF ground to maximize performance. | |
| 4 - 9 | ACG1 - ACG6 | External capacitor to ground is required. Select value for lowest frequency of operation. Place capacitor as close to pins as possible. | |
| 12 - 16 | V1 - V5 | See truth table and control voltage table. | |
| | GND | Package bottom has an exposed metal paddle that must also be connected to RF Ground. | |

Application Circuit



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Evaluation PCB



List of Materials for Evaluation EV1HMC470ALP3 [1]

| Item | Description |
|---------|--------------------------------|
| J1, J2 | PC Mount SMA Connector |
| J3 | 12 Pin DC Connector |
| C1 | 1000 pF Capacitor, 0603 Pkg. |
| C2, C3 | 1000 pF Capacitor, 0402 Pkg. |
| C4 - C7 | 330 pF Capacitor, 0402 Pkg. |
| U1 | HMC470ALP3E Digital Attenuator |
| PCB [2] | 106978 Evaluation PCB |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

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 Analog Devices Inc. upon request.