

HMC470ALP3E

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

Typical Applications

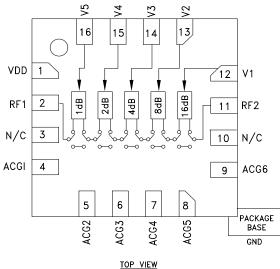
The HMC470ALP3E is ideal for:

- 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 \pm 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, $T_A = +25^{\circ}$ C, With Vdd = +5V & VctI = 0/+5V (Unless Otherwise Noted)

Parameter	Frequency (GHz)	Min.	Тур.	Max.	Units
Insertion Loss	DC - 1.5 GHz 1.5 - 2.3 GHz 2.3 - 3.0 GHz		1.3 1.5 1.7	1.6 1.8 2.0	dB dB 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 2.3 - 3.0 GHz 2.3 - 3.0 GHz	\pm (0.3 + 2% of Atten. Setting) Max. \pm (0.3 + 3% of Atten. Setting) Max. \pm (0.3 + 6% of Atten. Setting) Max.		dB dB dB	
Input Power for 0.1 dB Compression	0.1 - 3.0 GHz		27		dBm
Input Third Order Intercept PointREF-15d(Two-Tone Input Power= 10 dBm Each Tone)16 - 31d	01-30 GHz		49 48		dBm dBm
Switching Characteristics					
tRISE, tFALL (10/90% RF) tON, tOFF (50% CTL to 10/90% RF)	DC - 3 GHz		50 70		ns ns

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

HMC470A* Product Page Quick Links

Last Content Update: 08/30/2016

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

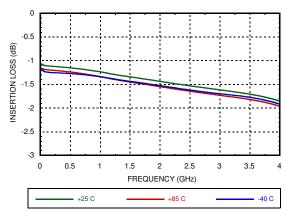
^{*} This page was dynamically generated by Analog Devices, Inc. and inserted into this data sheet. Note: Dynamic changes to the content on this page does not constitute a change to the revision number of the product data sheet. This content may be frequently modified.



Insertion Loss

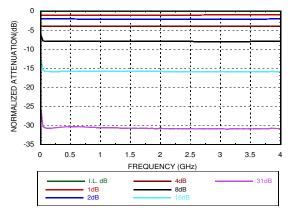
HMC470ALP3E

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

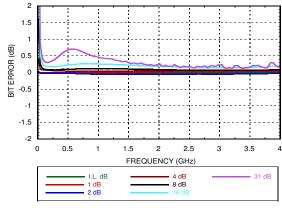


Normalized Attenuation

(Only Major States are Shown)

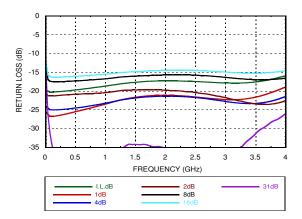




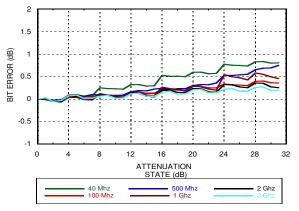


Return Loss RF1, RF2

(Only Major States are Shown)

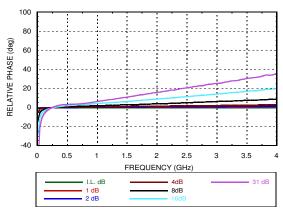


Bit Error vs. Attenuation State



Relative Phase vs. Frequency

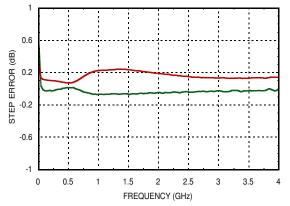
(Only Major States are Shown)





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

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
V1 16 dB	V2 8 dB	V3 4 dB	V4 2 dB	V5 1 dB	State RF1 - RF2
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.					



HMC470ALP3E v01.0716

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

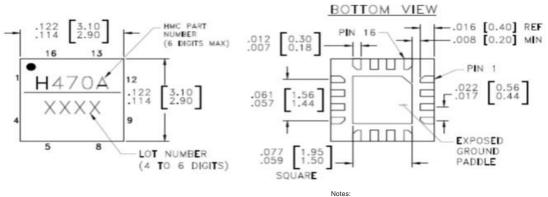
Absolute Maximum Ratings

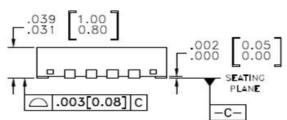
	1
RF Input Power (DC - 3 GHz)	+27 dBm (T = +85 °C)
Control Voltage Range (V1 to V5)	-1V to Vdd +1V
Bias Voltage (Vdd)	+7V
Channel Temperature	150 °C
Continuous Pdiss (T = 85 °C) (derate 7.7 mW/°C above 85 °C)	0.5 W
Thermal Resistance	130 °C/W
Storage Temperature	-65 to +150°C
Operating Temperature	-40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



ELECTROSTATIC SENSITIVE DEVICE **OBSERVE HANDLING PRECAUTIONS**

Outline Drawing





Notes: 1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION PLASTIC SILICA AND SILICON IMPREGNATED. 2. LEAD AND GROUND PADDLE MATERIAL: COPPER ALLOY.

LEAD AND GROUND PADDLE MATERIAL: COPPER ALLOY
LEAD AND GROUND PADDLE PLATING: 100% MATTE TIN.
DIMENSIONS ARE IN INCHES [MILLIMETERS].
LEAD SPACING TOLERANCE IS NON-CUMULATIVE.

6. CHARACTERS TO BE HELVETICA MEDIUM, .018 HIGH. WHITE INK, OR LASER MARK LOCATED APROX. AS SHOWN. 7. PAD BURR LENGTH BE 0.15mm MAX PAD BURR HEIGHT SHALL BE 0.05mm MAX.

8. PACKAGE WARP SHALL NOT EXCEED 0.05m

9. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND. 10.REFER TO ADI APPLICATION NOTES FOR SUGGESTED PCB LAND PATTERN.

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]	<u>H470A</u> XXXX

[1] Max peak reflow temperature of 260 C.

[2] 4- Digit lot number XXXX.

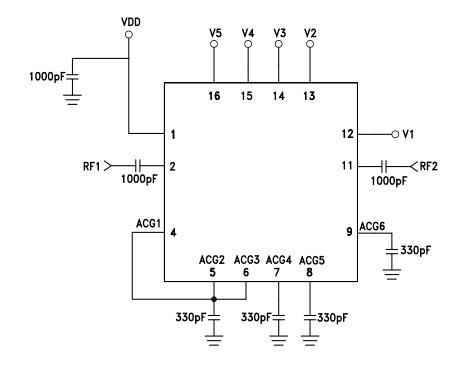


1 dB LSB GaAS MMIC 5-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 3 GHZ

Pin Descriptions

Pin Number	Function	Description Interface Schem	
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.	RF1,
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.	V1- <u>V5</u> 1.5K ↓ ↓
	GND	Package bottom has an exposed metal paddle that must also be connected to RF Ground.	

Application Circuit

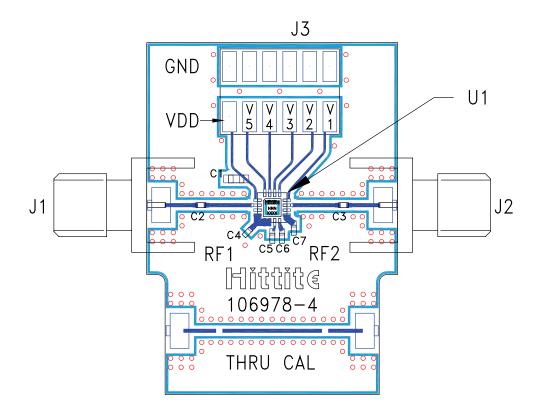




HMC470ALP3E

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

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.