



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of "Quality Parts,Customers Priority,Honest Operation,and Considerate Service",our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

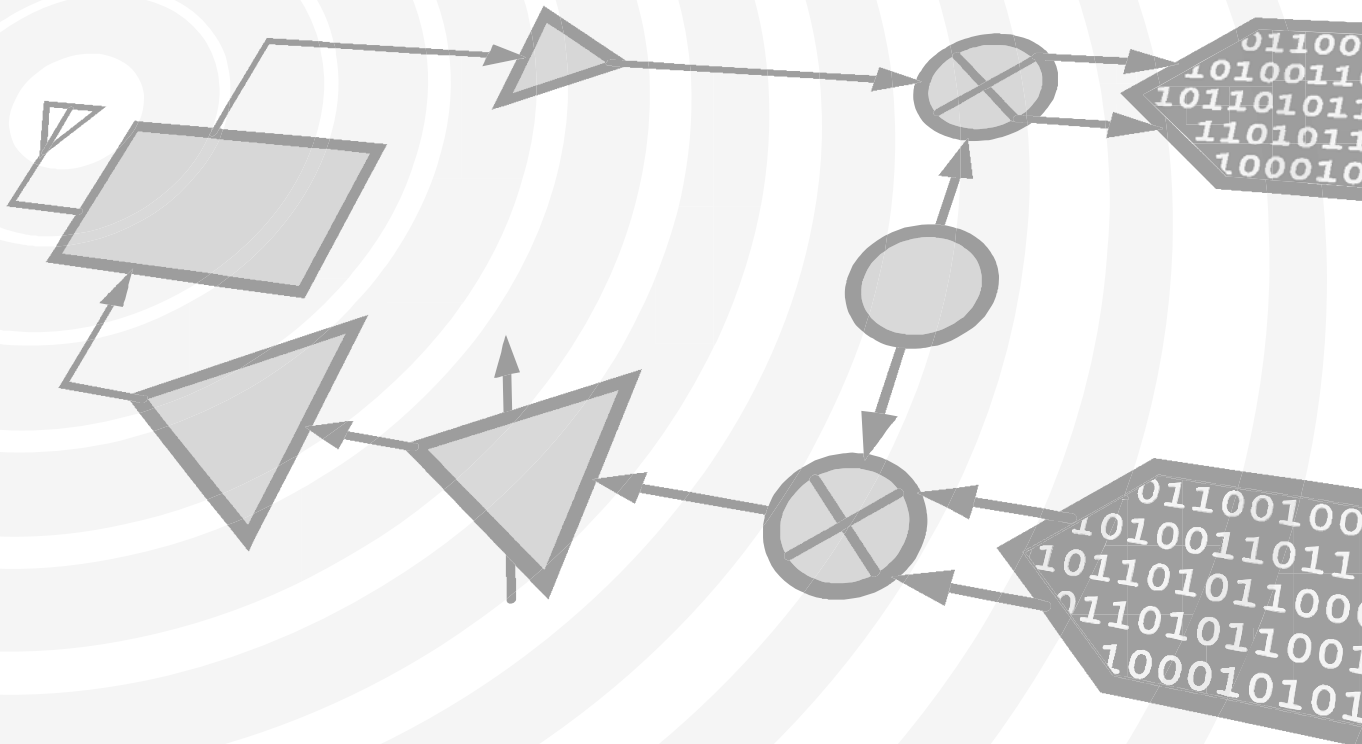
Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



Analog Devices Welcomes Hittite Microwave Corporation

NO CONTENT ON THE ATTACHED DOCUMENT HAS CHANGED



HMC472A* PRODUCT PAGE QUICK LINKS

Last Content Update: 02/23/2017

COMPARABLE PARTS

View a parametric search of comparable parts.

EVALUATION KITS

- HMC472ALP4 Evaluation Board

DOCUMENTATION

Data Sheet

- HMC472A Data Sheet

TOOLS AND SIMULATIONS

- HMC472A S-parameters

REFERENCE MATERIALS

Quality Documentation

- Package/Assembly Qualification Test Report: LP4, LP4B, LP4C, LP4K (QTR: 2013-00487 REV: 04)
- Semiconductor Qualification Test Report: PHEMT-J (QTR: 2013-00285)

DESIGN RESOURCES

- HMC472A Material Declaration
- PCN-PDN Information
- Quality And Reliability
- Symbols and Footprints

DISCUSSIONS

View all HMC472A 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

Submit feedback for this data sheet.

THIS PAGE INTENTIONALLY LEFT BLANK



0.5 dB LSB GaAs MMIC 6-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 3.8 GHz

Typical Applications

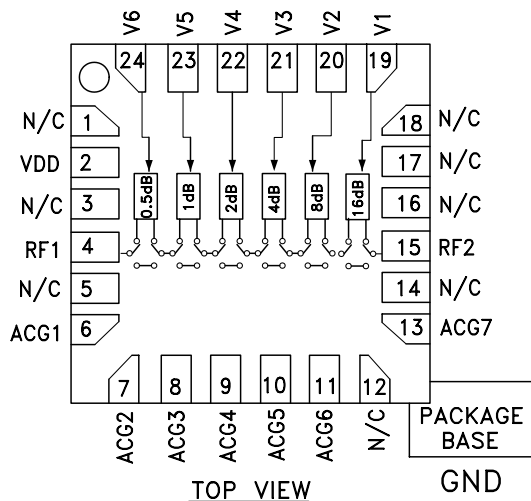
The HMC472ALP4E is ideal for:

- 3G Infrastructure & access points
- Cellular/3G, LTE & UMB
- WiMAX, WiBN & Fixed Wireless
- Test Equipment and Sensors
- GSM, WCDMA & TD-SCDMA

Features

- 0.5 dB LSB Steps to 31.5 dB
- Single Control Line Per Bit
- TTL/CMOS Compatible Control
- ± 0.25 dB Typical Step Error
- Single +5V Supply
- 24 Lead Ceramic 4x4mm SMT Package: 16mm²

Functional Diagram



General Description

The HMC472ALP4E are broadband 6-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 3.8 GHz, the insertion loss is less than 2.0 dB typical. The attenuator bit values are 0.5 (LSB), 1, 2, 4, 8, and 16 dB for a total attenuation of 31.5 dB. Attenuation accuracy is excellent at ± 0.25 dB typical step error with an IIP3 of +54 dBm. Six 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 $V_{dd} = +5V$ & $V_{ctl} = 0/+5V$ (Unless Otherwise Noted)

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Insertion Loss	DC - 1.5 GHz		1.4	1.8	dB
	1.5 - 3.0 GHz		1.7	2.3	dB
	3.0 - 3.8 GHz		1.9	3	dB
Attenuation Range	DC - 3.8 GHz		31.5		dB
Return Loss (RF1 & RF2, All Atten. States)	DC - 3.8 GHz		20		dB
Attenuation Accuracy: (Referenced to Insertion Loss)					
All Attenuation States	DC - 1.0 GHz	± (0.20 + 3% of Atten. Setting) Max.			dB
0.5 - 3.5 dB States	1.0 - 2.2 GHz	± (0.25 + 3% of Atten. Setting) Max.			dB
4.0 - 31.5 dB States	1.0 - 2.2 GHz	± (0.15 + 4% of Atten. Setting) Max.			dB
All Attenuation States	2.2 - 3.0 GHz	± (0.30 + 3% of Atten. Setting) Max.			dB
All Attenuation States	3.0 - 3.8 GHz	± (0.35 + 5% of Atten. Setting) Max.			dB
Input Power for 0.1 dB Compression	0.1 - 3.8 GHz		30		dBm
Input Third Order Intercept Point (Two-Tone Input Power= 0 dBm Each Tone)	0.1 - 3.8 GHz	REF - 15.5 dB States	54		dBm
		16.0 - 31.5 dB States	49		dBm
Switching Characteristics					
tRISE, tFALL (10/90% RF)	DC - 3.8 GHz		40		ns
tON, tOFF (50% CTL to 10/90% RF)			60		ns

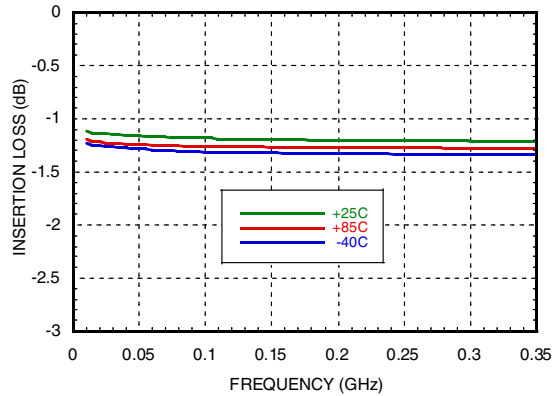
For price, delivery and to place orders: Hittite Microwave Corporation, 2 Elizabeth Drive, Chelmsford, MA 01824

Phone: 978-250-3343 Fax: 978-250-3373 Order On-line at www.hittite.com

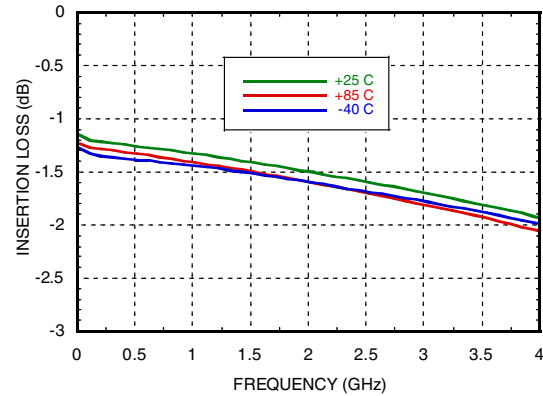
Application Support: Phone: 978-250-3343 or apps@hittite.com

0.5 dB LSB GaAs MMIC 6-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 3.8 GHz

Insertion Loss

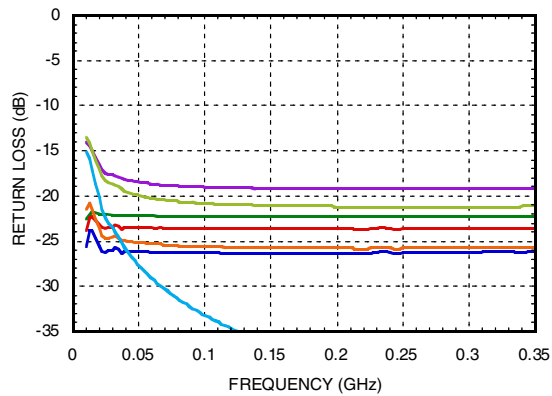


Insertion Loss



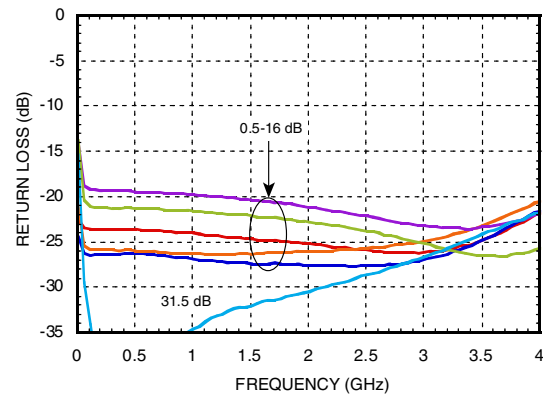
Return Loss RF1, RF2

(Only Major States are Shown)



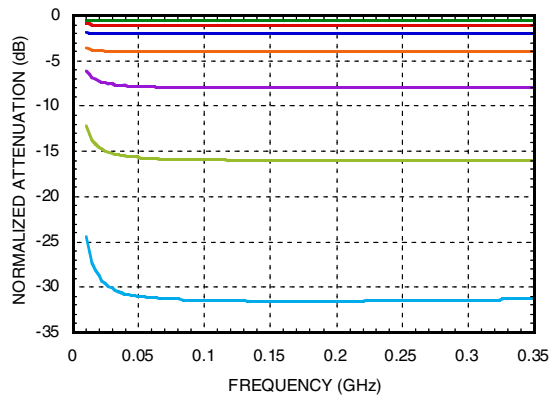
Return Loss RF1, RF2

(Only Major States are Shown)



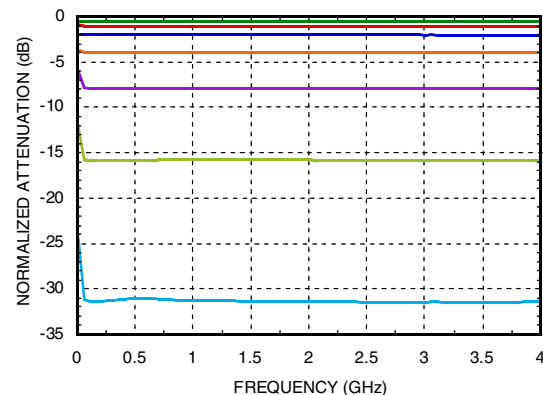
Normalized Attenuation

(Only Major States are Shown)



Normalized Attenuation

(Only Major States are Shown)

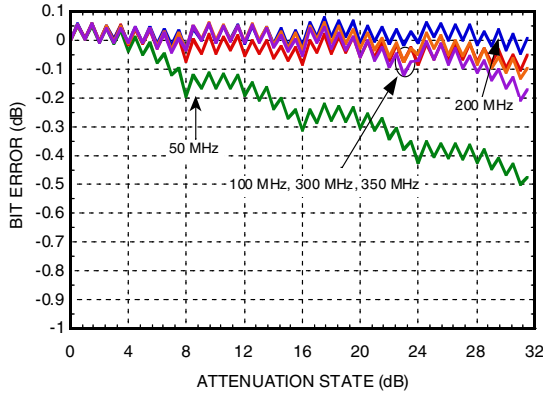




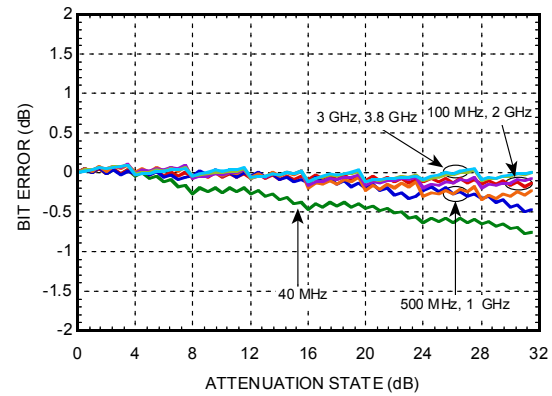
0.5 dB LSB GaAs MMIC 6-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 3.8 GHz

ATTENUATORS - DIGITAL - SMT

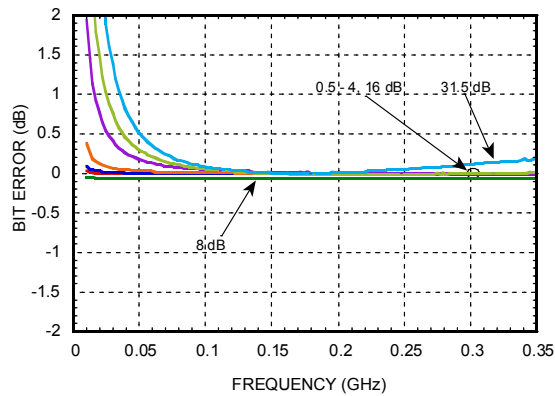
Bit Error vs. Attenuation State



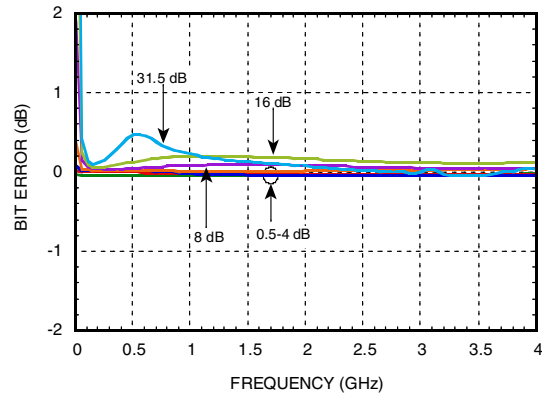
Bit Error vs. Attenuation State



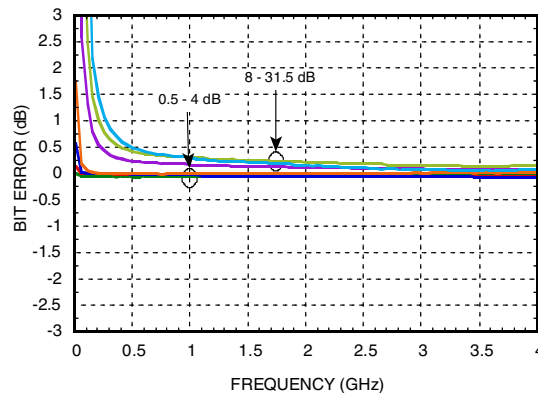
Bit Error vs. Frequency
(Only Major States are Shown)



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



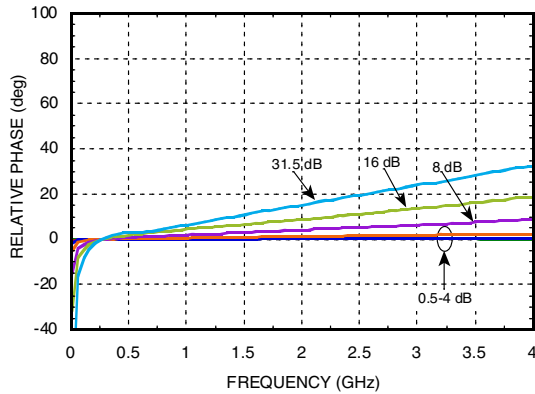
Bit Error vs. Frequency without AC Ground Caps
(Only Major States are Shown)



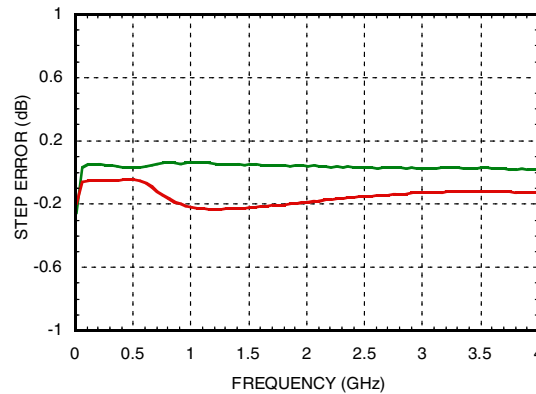


0.5 dB LSB GaAs MMIC 6-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 3.8 GHz

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



Worst Case Step Error Between Successive Attenuation States



Bias Voltage & Current

Vdd = +5V ± 10%	
Vdd (V)	Idd (Typ.) (mA)
+4.5	2.4
+5.0	2.5
+5.5	2.6

Control Voltage

State	Bias Condition
Low	0 to +0.8 Vdc @ -5 uA Typ.
High	+ 2.0 to + 5.0 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	V6 0.5 dB	
High	High	High	High	High	High	Reference I.L.
High	High	High	High	High	Low	0.5 dB
High	High	High	High	Low	High	1 dB
High	High	High	Low	High	High	2 dB
High	High	Low	High	High	High	4 dB
High	Low	High	High	High	High	8 dB
Low	High	High	High	High	High	16 dB
Low	Low	Low	Low	Low	Low	31.5 dB

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



0.5 dB LSB GaAs MMIC 6-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 3.8 GHz

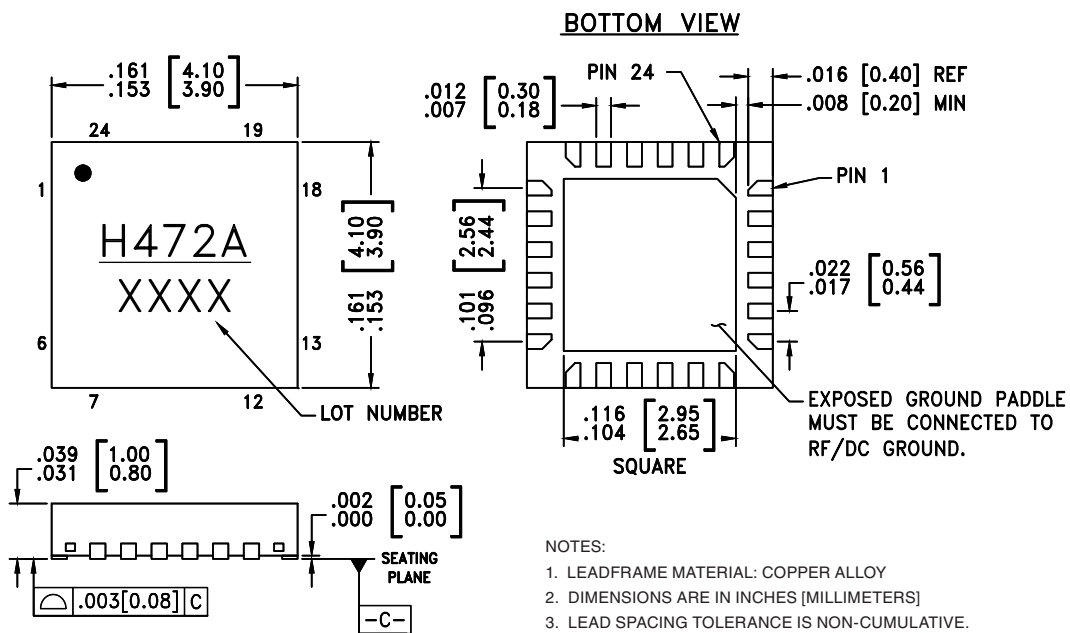
Absolute Maximum Ratings

RF Input Power (DC - 3 GHz)	+28 dBm (T = +85 °C)
Control Voltage Range (V1 to V6)	-1V to Vdd +1V
Bias Voltage (Vdd)	+7V
Channel Temperature	150 °C
Continuous Pdiss (T = 85 °C) (derate 8.6 mW/°C above 85 °C)	0.56 W
Thermal Resistance	116 °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



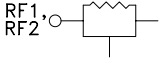
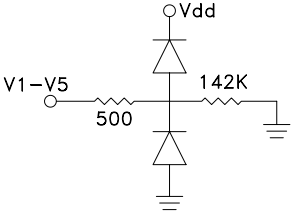

Package Information

Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking ^[2]
HMC472ALP4E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 ^[1]	H472A XXXX

[1] Max peak reflow temperature of 260 °C

[2] 4-Digit lot number XXXX

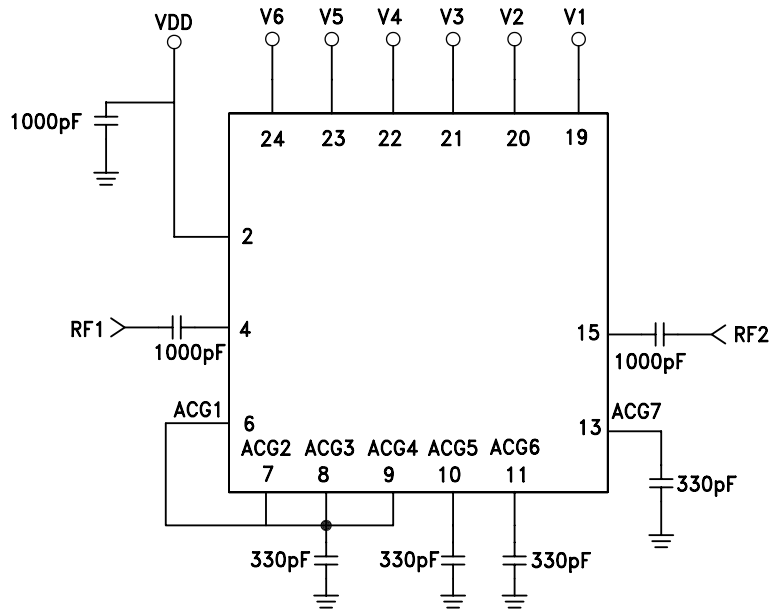

0.5 dB LSB GaAs MMIC 6-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 3.8 GHz
Pin Descriptions

Pin Number	Function	Description	Interface Schematic
1, 3, 5, 12, 14, 16, 17, 18	N/C	These pins should be connected to PCB RF ground to maximize performance.	
2	Vdd	Supply Voltage.	
4, 15	RF1, RF2	This pin is DC coupled and matched to 50 Ohm. Blocking capacitors are required. Select value based on lowest frequency of operation.	
6 - 11, 13	ACG1 - ACG7	External capacitors to ground are recommended for low and high frequency operation. Select value for lowest frequency of operation. Place capacitor as close to pins as possible. For operation from 700 to 2700 MHz, these pins may be left unconnected.	
19 - 24	V1 - V6	See truth table and control voltage table.	
	GND	Package bottom has an exposed metal paddle that must also be connected to RF/DC Ground.	

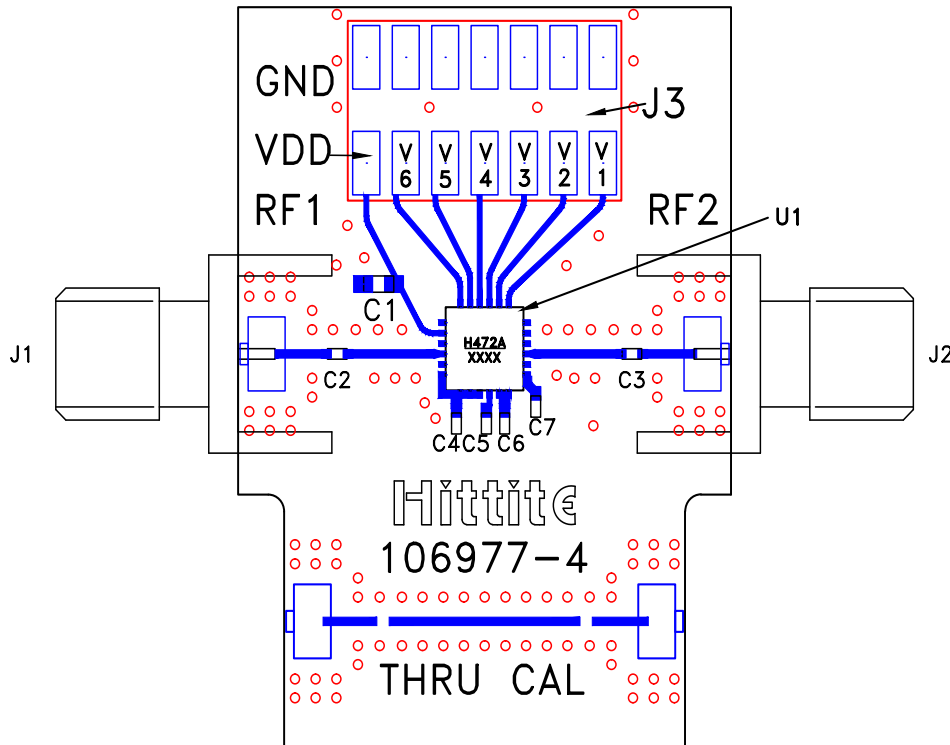


**0.5 dB LSB GaAs MMIC 6-BIT DIGITAL
POSITIVE CONTROL ATTENUATOR, DC - 3.8 GHz**

Application Circuit



Note: For operations from 700 to 2700 MHz, pins 6 through 13 may be left unconnected.

**0.5 dB LSB GaAs MMIC 6-BIT DIGITAL
POSITIVE CONTROL ATTENUATOR, DC - 3.8 GHz**
Evaluation PCB

List of Materials for Evaluation PCB 107010 - HMC472ALP4 [1]

Item	Description
J1 - J2	PCB Mount SMA Connector
J3	14 Pin DC Connector
C1	1000 pF Capacitor, 0603 Pkg.
C2, C3	1000 pF Capacitor, 0402 Pkg.
C4 - C7	330 pF Capacitor, 0402 Pkg.
U1	HMC472ALP4E Digital Attenuator
PCB [2]	106977 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 Hittite upon request.