HMC425LP3 / 425LP3E

v03.0409

0.5 dB LSB GaAs MMIC 6-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, 2.2 - 8.0 GHz

Typical Applications

The HMC425LP3 / HMC425LP3E is ideal for:

- WLAN & Point-to-Multi-Point
- Fiber Optics & Broadband Telecom
- Microwave Radio & VSAT
- Military

Features

0.5 dB LSB Steps to 31.5 dB

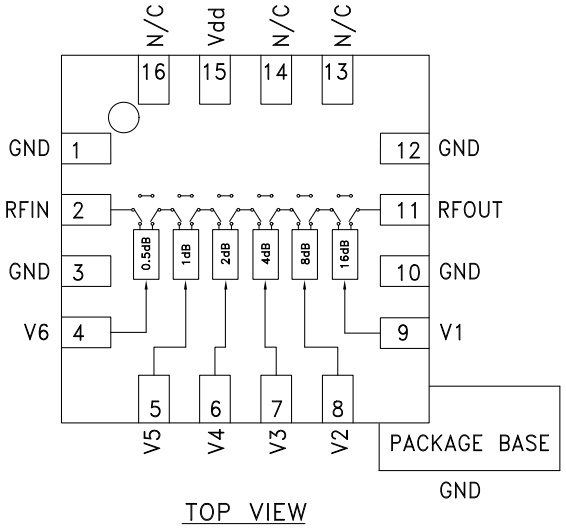
Single Control Line Per Bit

± 0.5 dB Typical Bit Error

Single +5V Supply

3x3 mm SMT Package

Functional Diagram



TOP VIEW

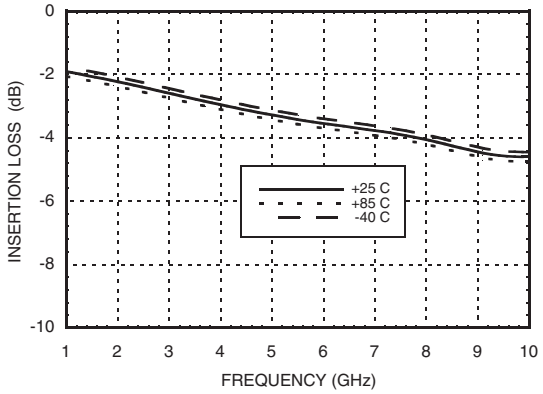
General Description

The HMC425LP3 & HMC425LP3E are broadband 6-bit GaAs IC digital attenuators in low cost leadless surface mount packages. Covering 2.2 to 8.0 GHz, the insertion loss is less then 3.8 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 ± 0.5 dB typical step error with an IIP3 of +40 dBm. Six control voltage inputs, toggled between 0 and +3 to +5V, are used to select each attenuation state. A single Vdd bias of +3 to +5V is required.

Electrical Specifications, T_A = +25° C, With Vdd = +5V & Vctl = 0/+5V (Unless Otherwise Noted)

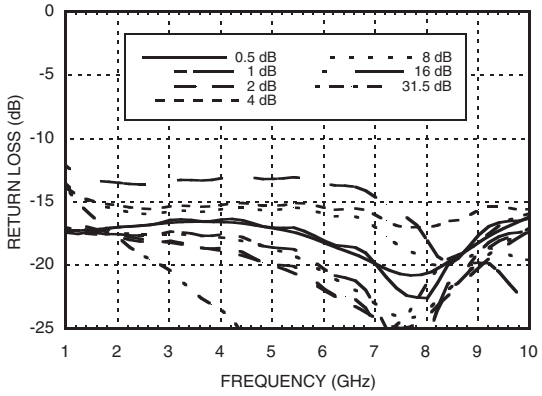
Parameter		Frequency (GHz)	Min.	Typ.	Max.	Units
Insertion Loss		2.2 - 6.0 GHz 6.0 - 8.0 GHz		3.5 3.8	3.8 4.3	dB dB
Attenuation Range		2.2 - 8.0 GHz		31.5		dB
Return Loss (RF1 & RF2, All Atten. States)		2.2 - 8.0 GHz		15		dB
Attenuation Accuracy: (Referenced to Insertion Loss)	All States	2.2 - 8.0 GHz	± 0.5 + 5% of Atten. Setting Max.			dB
Input Power for 0.1 dB Compression	Vdd = 5V Vdd = 3V	2.2 - 8.0 GHz		22 19		dBm dBm
Input Third Order Intercept Point (Two-Tone Input Power= 0 dBm Each Tone)	REF - 16.0 dB States 16.5 - 31.5 dB States	2.2 - 8.0 GHz		45 35		dBm dBm
Switching Characteristics tRISE, tFALL (10/90% RF) tON, tOFF (50% CTL to 10/90% RF)		2.2 - 8.0 GHz		 160 180		 ns ns

Insertion Loss



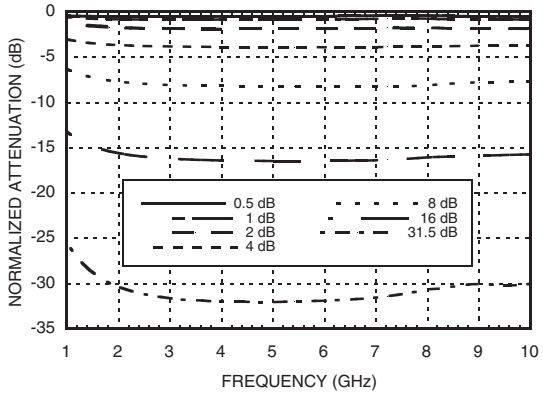
Return Loss RF1, RF2

(Only Major States are Shown)

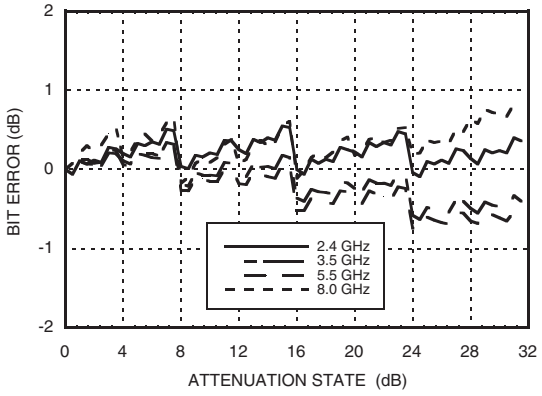


Normalized Attenuation

(Only Major States are Shown)

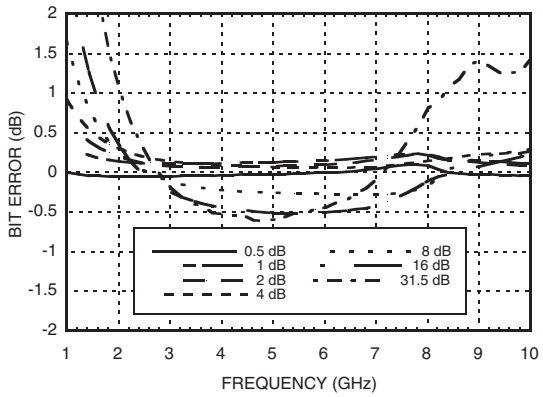


Bit Error vs. Attenuation State



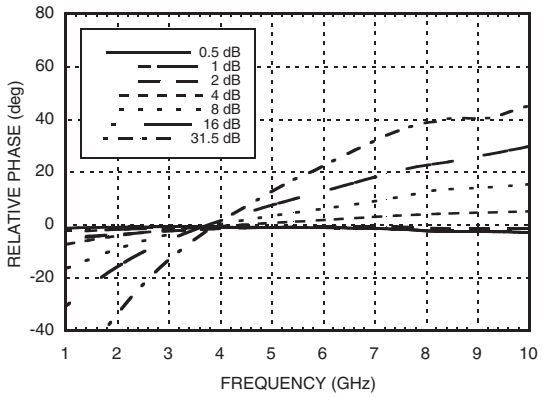
Bit Error vs. Frequency

(Only Major States are Shown)



Relative Phase vs. Frequency

(Only Major States are Shown)



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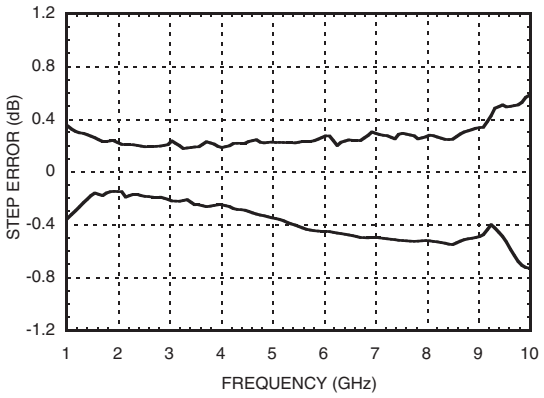
Worst Case Step Error Between Successive Attenuation States



Bias Voltage & Current

Vdd Range = 3.0 to +5.0 Vdc	
Vdd (VDC)	Idd (Typ.) (µA)
+3.0	10
+5.0	30

Control Voltage

State	Bias Condition
Low	0 to 0.2V @ 10 uA Typ.
High	Vdd ± 0.2V @ 5 uA Typ.
Note: Vdd = +3V to +5V	

Truth Table

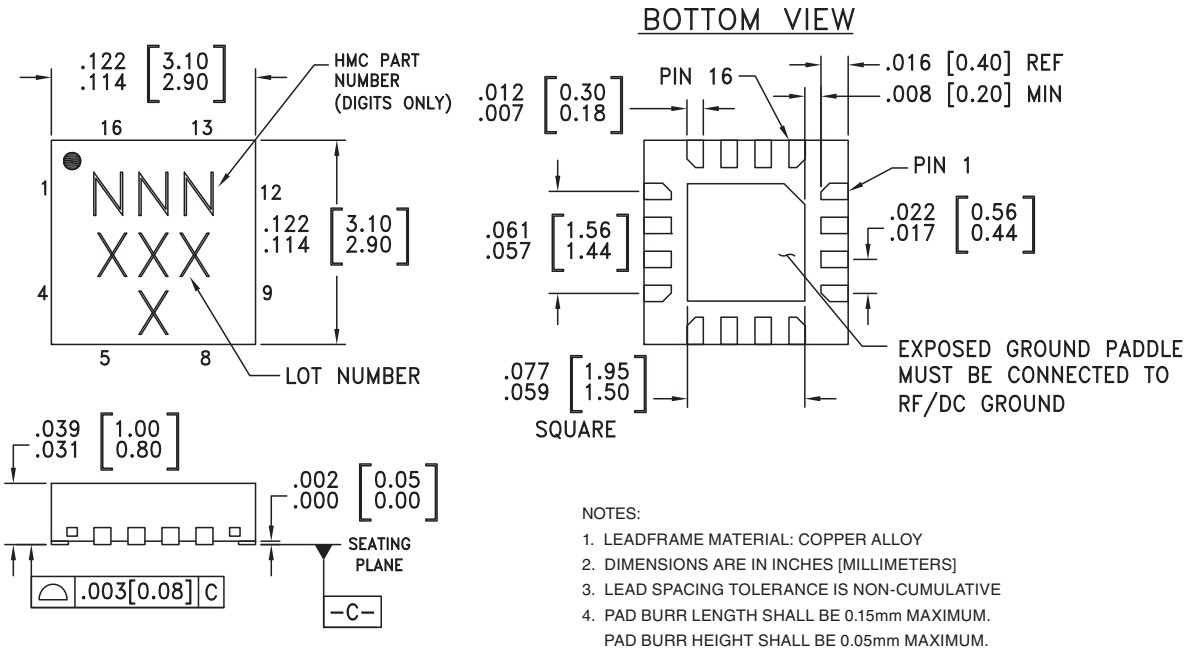
Control Voltage Input						Attenuation State RF1 - RF2
V1 16 dB	V2 8 dB	V3 4 dB	V4 2 dB	V5 1 dB	V6 0.5 dB	
High	High	High	High	High	High	Reference I.L.
High	High	High	High	High	Low	0.5 dB
High	High	High	High	Low	High	1 dB
High	High	High	Low	High	High	2 dB
High	High	Low	High	High	High	4 dB
High	Low	High	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.						

Absolute Maximum Ratings

Control Voltage (V1 to V6)	Vdd +0.5 Vdc
Bias Voltage (Vdd)	+7.0 Vdc
Staorage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C
RF Input Power (2.4 - 8.0 GHz)	+30 dBm
ESD Sensitivity (HBM)	Class 1A

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



NOTES:

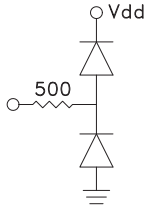
1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE
4. PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM. PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
5. PACKAGE WARP SHALL NOT EXCEED 0.05mm.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
7. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.

Package Information

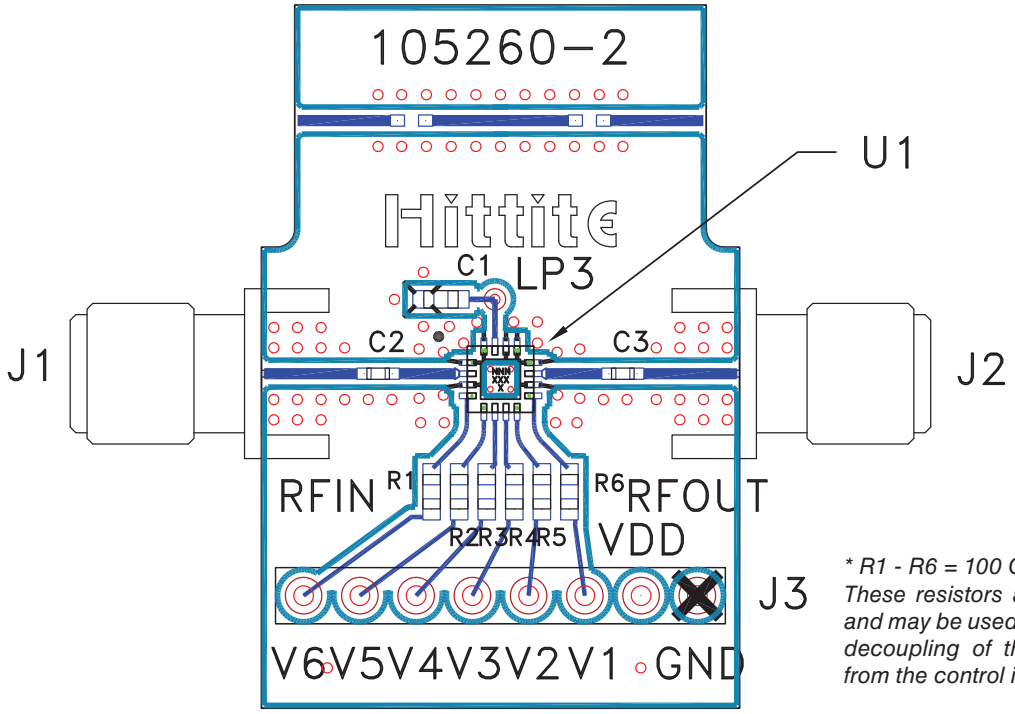
Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking [3]
HMC425LP3	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL1 [1]	425 XXXX
HMC425LP3E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 [2]	425 XXXX

[1] Max peak reflow temperature of 235 °C
[2] Max peak reflow temperature of 260 °C
[3] 4-Digit lot number XXXX

Pin Descriptions

Pin Number	Function	Description	Interface Schematic
1, 3, 10, 12	GND	Package bottom has an exposed metal paddle that must also be connected to RF ground.	
2, 11	RFIN, RFOUT	This pin is DC coupled and matched to 50 Ohm. Blocking capacitors are required.	
4, 5, 6, 7, 8, 9	V1 - V6	See truth table and control voltage table.	
13, 14, 16	N/C	This pin should be connected to PCB RF ground to maximize performance.	
15	Vdd	Supply Voltage.	

Evaluation PCB



** R1 - R6 = 100 Ohm. These resistors are optional and may be used to enhance decoupling of the RF path from the control inputs.*

List of Materials for Evaluation PCB 105408 [1]

Item	Description
J1 - J2	PCB Mount SMA Connector
J3	8 Pin DC Connector
C1	0.01 µF Capacitor, 0603 Pkg.
C2, C3	100 pF Capacitor, 0402 Pkg.
R1 - R6	100 Ohm Resistor, 0603 Pkg.
U1	HMC425LP3 / HMC425LP3E Digital Attenuator
PCB [2]	105260 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 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.