

2 dB LSB GaAs MMIC 2-BIT DIGITAL POSITIVE CONTROL ATTENUATOR, DC - 6.0 GHz

Typical Applications

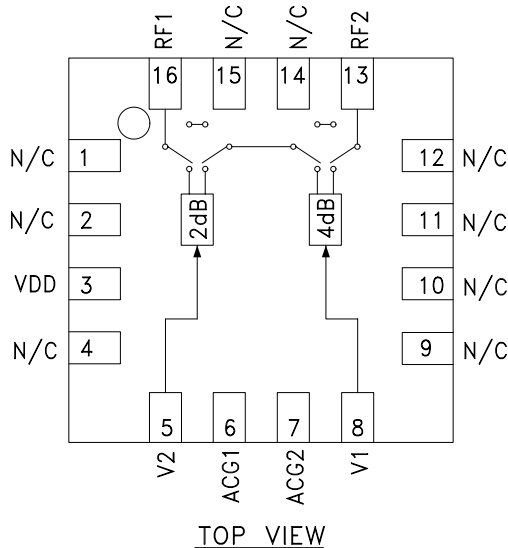
The HMC467LP3 is ideal for:

- Cellular; UMTS/3G Infrastructure
- Fixed Wireless & WLL
- Microwave Radio & VSAT
- Test Equipment

Features

- 2 dB LSB Steps to 6 dB
- High IP3: +50 dBm
- +/- 0.2 dB Typical Bit Error
- Single Control Line Per Bit
- Single +5V Supply
- 3 mm x 3 mm x 1 mm SMT Package

Functional Diagram



General Description

The HMC467LP3 is a broadband 2-bit GaAs IC digital attenuator in a low cost leadless surface mount package. Covering DC to 6.0 GHz, the insertion loss is less than 0.7 dB typical. The attenuator bit values are 2 (LSB) and 4 dB for a total attenuation of 6 dB. Attenuation accuracy is excellent at ± 0.2 dB typical step error with an IIP3 of +50 dBm. Two control voltage inputs, toggled between 0 and +5V, are used to select each attenuation state. A single Vdd bias of +5V is required.

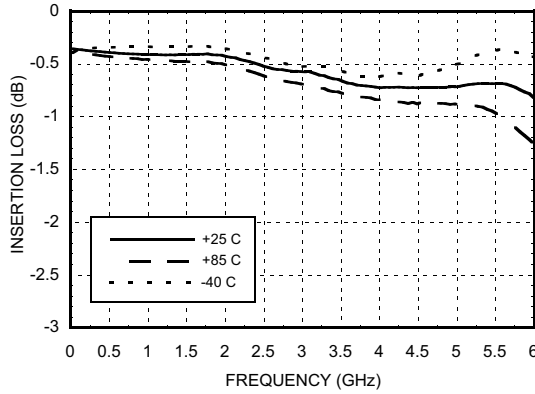
Electrical Specifications, $T_A = +25^\circ\text{C}$, With $V_{dd} = +5\text{V}$ & $V_{ctl} = 0/+5\text{V}^*$

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Insertion Loss	DC - 2.5 GHz		0.5	0.8	dB
	2.5 - 6.0 GHz		0.8	1.2	dB
Attenuation Range	DC - 6.0 GHz		6		dB
Return Loss (RF1 & RF2, All Atten. States)	DC - 2.5 GHz		20		dB
	2.5 - 6.0 GHz		15		dB
Attenuation Accuracy: (Referenced to Insertion Loss)	DC - 6.0 GHz		2 dB State	$\pm 0.2 + 2\%$ of Atten. Setting Max.	dB
			4, 6 dB States		$\pm 0.4 + 2\%$ of Atten. Setting Max.
Input Power for 0.1 dB Compression	0.25 - 6.0 GHz		22		dBm
Input Third Order Intercept Point (Two-Tone Input Power = 0 dBm Each Tone)	0.25 - 6.0 GHz		50		dBm
Switching Characteristics	DC - 6.0 GHz				
			tRISE, tFALL (10/90% RF)	135	ns
			tON, tOFF (50% CTL to 10/90% RF)	155	ns

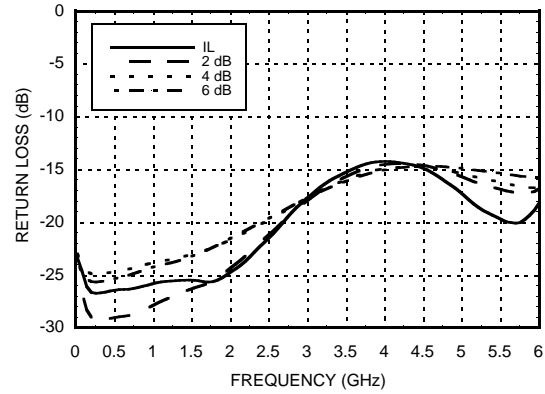
* Bypass capacitor connecting ACG1 & ACG2 to RF ground required per pin description herein.

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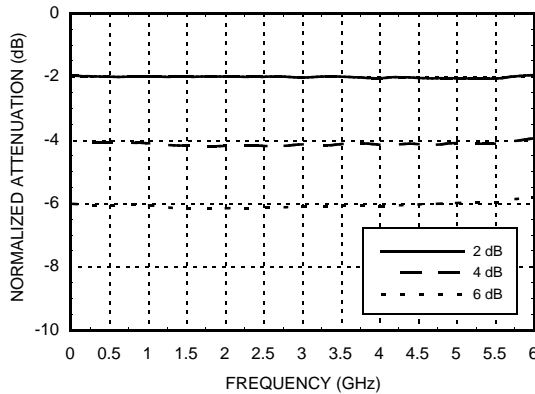
Insertion Loss



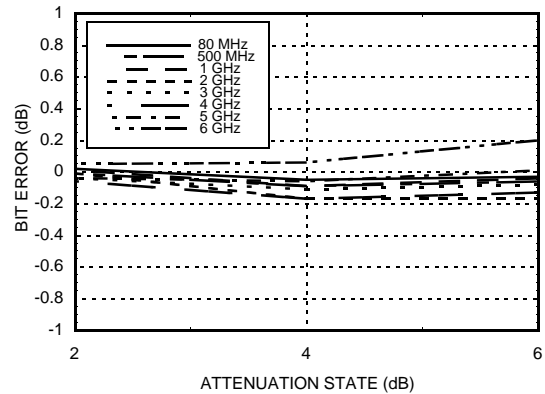
Return Loss RF1, RF2
(Only Major States are Shown)



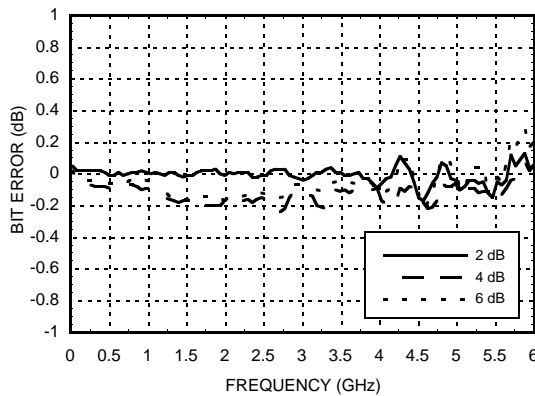
Normalized Attenuation
(Only Major States are Shown)



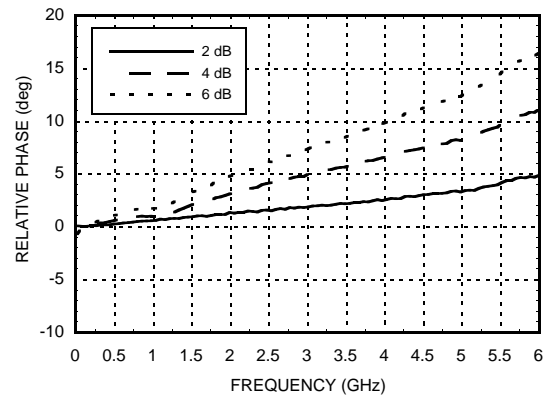
Bit Error vs. Attenuation State



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

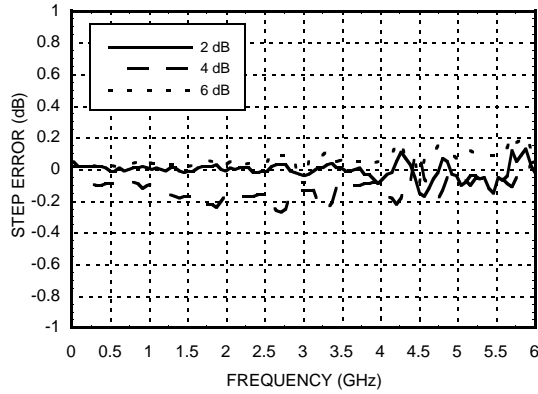


Relative Phase vs. Frequency
(Only Major States are Shown)



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Worst Case Step Error Between Successive Attenuation States



Bias Voltage & Current

Vdd Range= +5.0 Vdc ± 10%		
Vdd (Vdc)	Idd (Typ.) (mA)	Idd (Max.) (mA)
+5.0	0.7	1.2

TTL/CMOS Control Voltages

State	Bias Condition
Low	0 to 0.8 Vdc @ -5 uA Typ.
High	+2.0 to +5.0 Vdc @ 40 uA Typ.

Truth Table

Control Voltage Input		Attenuation Setting RF1 - RF2
V1 4 dB	V2 2 dB	
High	High	Reference I.L.
High	Low	2 dB
Low	High	4 dB
Low	Low	6 dB Max. Atten.

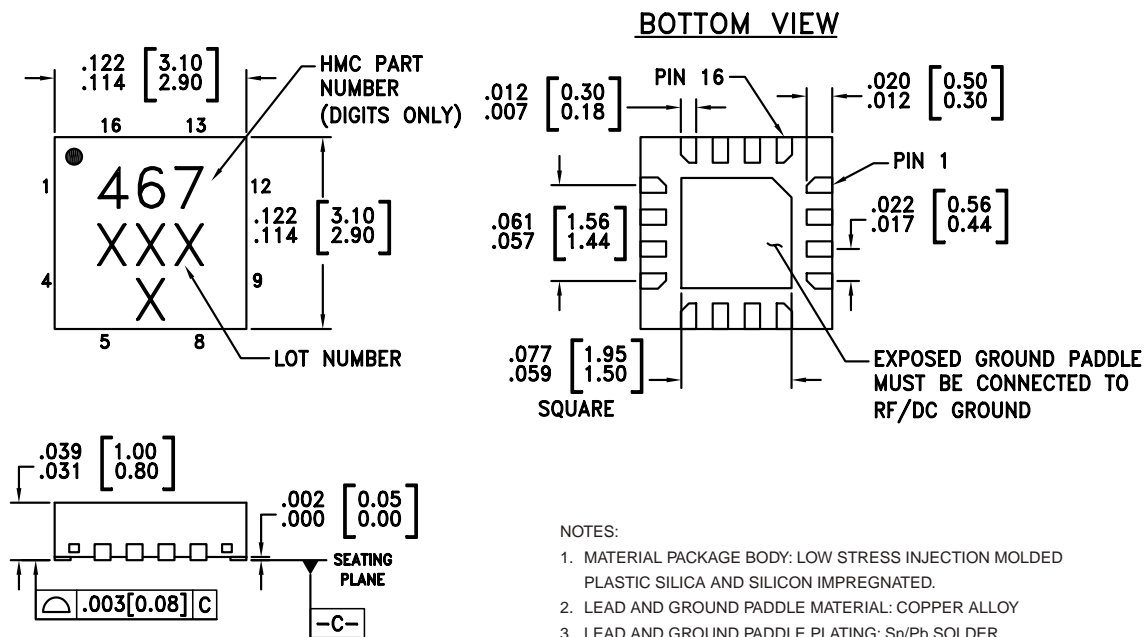
Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

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Absolute Maximum Ratings

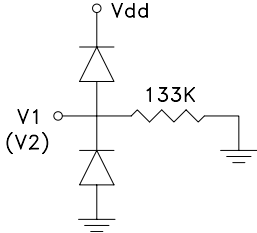
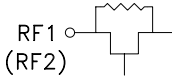

Control Voltage (V1, V2)	-0.5 Vdc to Vdd +1 Vdc
Bias Voltage (Vdd)	+7.0 Vdc
Storage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C
RF Input Power	+30 dBm

Outline Drawing

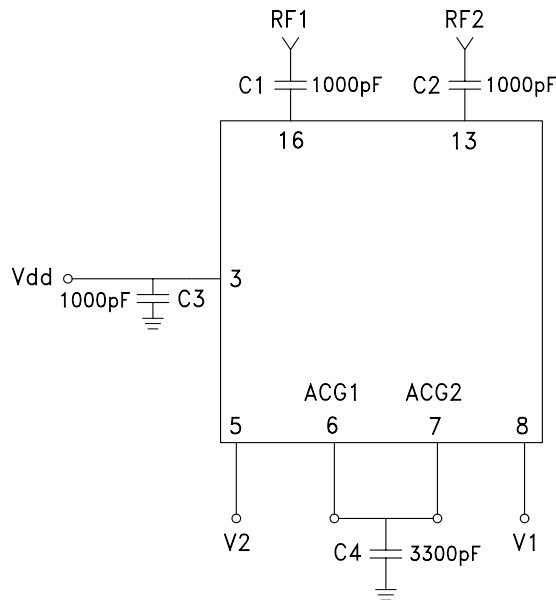


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Pin Descriptions

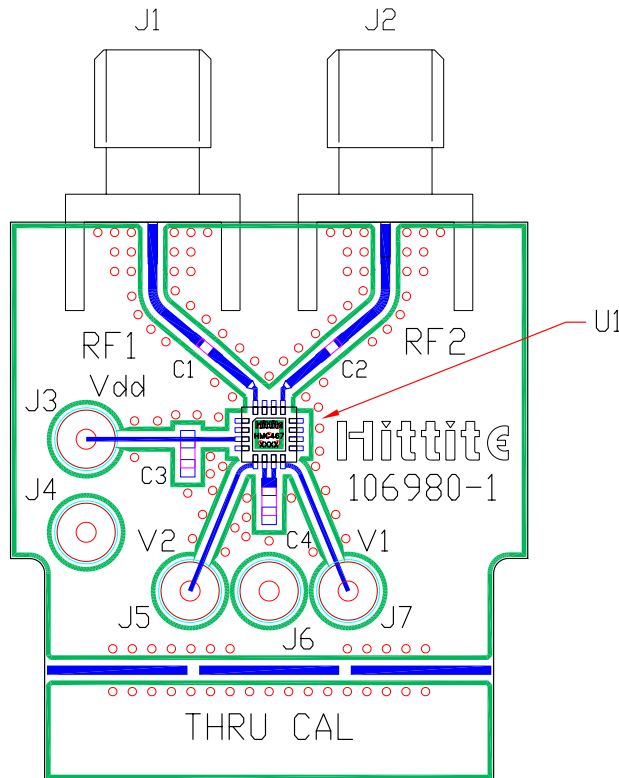
Pin Number	Function	Description	Interface Schematic
1, 2, 4, 9 - 12, 14, 15	N/C	These pins should be connected to PCB RF ground to maximize performance.	
3	Vdd	Supply Voltage	
5, 8	V2, V1	See truth table and control voltage table.	
6, 7	ACG1, ACG2	External capacitor to ground is required. Select value for lowest frequency of operation. Place capacitor as close to pins as possible.	
13, 16	RF2, RF1	These pins are DC coupled and matched to 50 Ohm. Blocking capacitors are required.	
	GND	Package bottom has an exposed metal paddle that must be connected to RF/DC ground.	

Application Circuit



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Evaluation PCB



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.

List of Material

Item	Description
J1 - J2	PC Mount SMA Connector
J3 - J7	DC Pin
C1, C2	1000 pF Capacitor, 0402 Pkg.
C3	1000 pF Capacitor, 0603 Pkg.
C4	3300 pF Capacitor, 0603 Pkg.
U1	HMC467LP3 Digital Attenuator
PCB*	106980 Evaluation PCB

* Circuit Board Material: Rogers 4350