HMC307QS16G

1dB LSB GaAs MMIC 5-BIT DIGITAL ATTENUATOR, DC - 4 GHz

Typical Applications

The HMC307QS16G is ideal for:

- Cellular
- PCS, ISM, MMDS
- Wireless Local Loop

Features

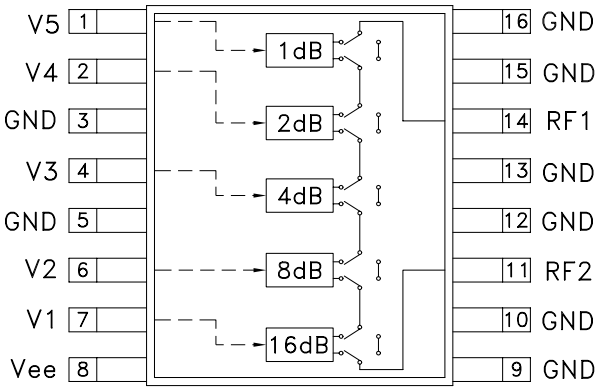
1 dB LSB Steps to 31 dB

Single Control Line Per Bit

+/- 0.5 dB Typical Bit Error

Miniature QSOP-16 Package: 29.4 mm^2

Functional Diagram



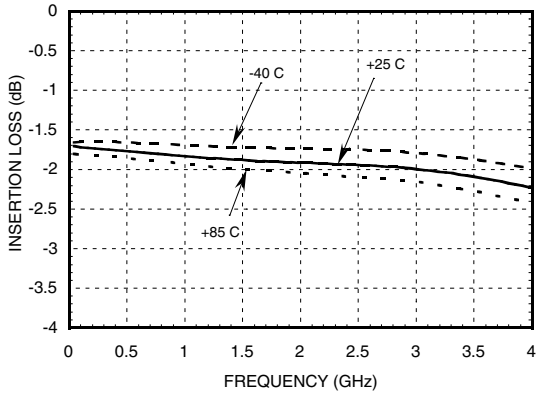
General Description

The HMC307QS16G is a broadband 5-bit GaAs IC digital attenuator in a 16 lead QSOP grounded base surface mount plastic package. Covering DC to 4 GHz, the insertion loss is less then 2 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 ± 0.5 dB typical with an IIP3 of up to +44 dBm. Five bit control voltage inputs, toggled between 0 and -5V, are used to select each attenuation state at less than 50 uA each. A single Vee bias of -5V allows operation down to DC. This product is an excellent alternative to the HMC235QS16G.

Electrical Specifications, T_A = +25° C, Vee = -5V & VCTL= 0/Vee

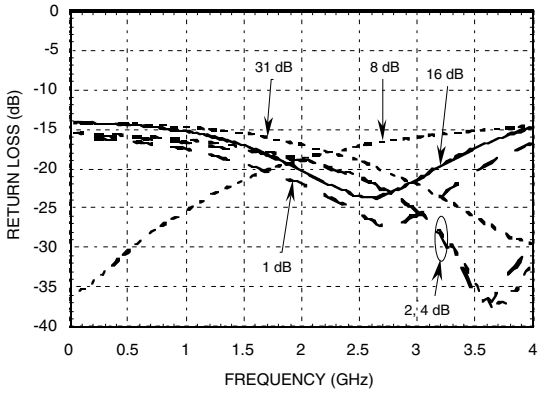
Parameter	Frequency	Min.	Typical	Max.	Units
Insertion Loss	DC - 1.4 GHz 1.4 - 2.3 GHz 2.3 - 2.7 GHz 2.7 - 4.0 GHz		1.8 1.9 2.0 2.1	2.2 2.4 2.5 2.7	dB dB dB dB
Attenuation Range	DC - 4.0 GHz		31		dB
Return Loss (RF1 & RF2, All Atten. States)	DC - 1.4 GHz 1.4 - 2.3 GHz 2.3 - 2.7 GHz 2.7 - 4.0 GHz	11 11 10 8	15 17 18 15		dB dB dB dB
Attenuation Accuracy: (Referenced to Insertion Loss) 1 - 20 dB States 21 - 31 dB States 1 - 15 dB States 16 - 31 dB States	 DC - 2.7 GHz DC - 2.7 GHz 2.7 - 4.0 GHz 2.7 - 4.0 GHz	 ± 0.2 + 3% of Atten. Setting Max ± 0.3 + 5% of Atten. Setting Max ± 0.3 + 5% of Atten. Setting Max ± 0.6 + 10% of Atten. Setting Max			 dB dB dB dB
Input Power for 0.1 dB Compression	0.5 - 4.0 GHz		24		dBm
Input Third Order Intercept Point (Two-tone Input Power = 0 dBm Each Tone)	0.5 - 4.0 GHz		44		dBm
Switching Characteristics tRISE, tFALL (10/90% RF) tON, tOFF (50% CTL to 10/90% RF)	DC - 4.0 GHz		 140 160		 ns ns

Insertion Loss



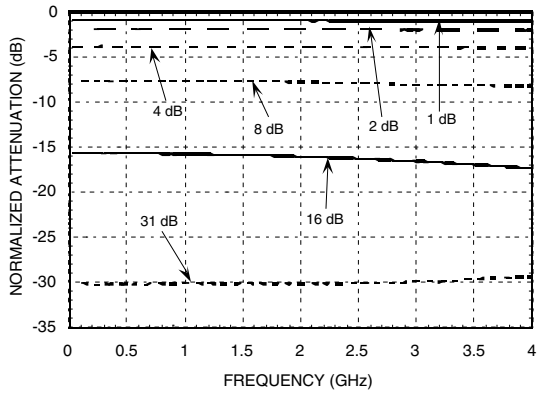
Return Loss RF1, RF2

(Only Major States are Shown)

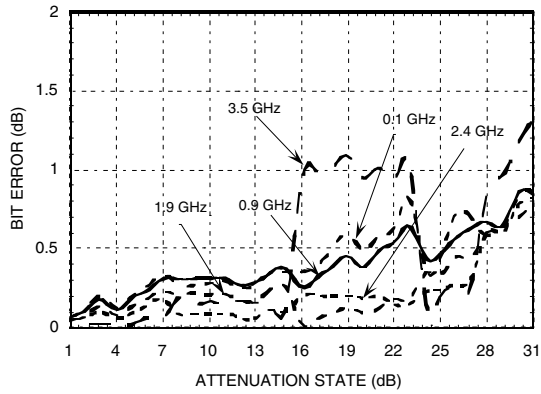


Normalized Attenuation

(Only Major States are Shown)

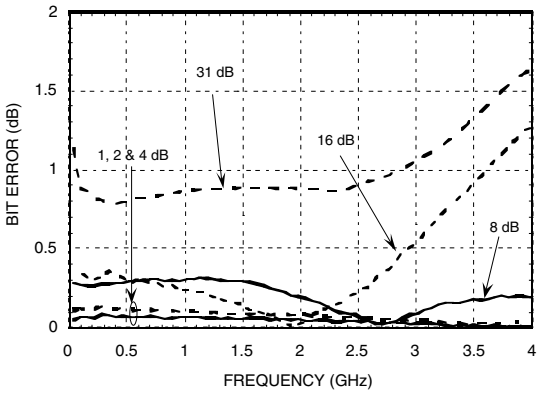


Absolute Bit Error vs. Attenuation State



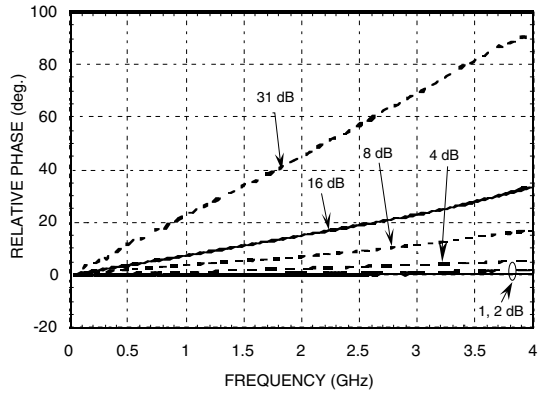
Absolute Bit Error vs. Frequency

(Only Major States are Shown)



Relative Phase vs. Frequency

(Only Major States are Shown)



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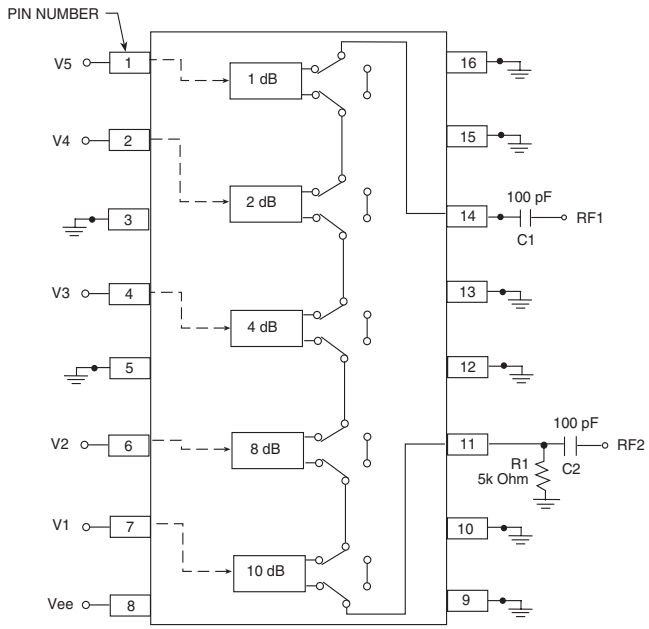
Application Circuit



DC Blocking Capacitors C1 & C2 are required on RF1 & RF2. Choose C1 = C2 = 100 pF ~ 0.1 uF to allow lowest customer specific frequency to pass with minimal loss. R1= 5K Ohm is required to supply voltage to the circuit through either Pin 11 or Pin 14.

Truth Table

Control Voltage Input					Attenuation State RF1 - RF2
V1 16 dB	V2 8 dB	V3 4 dB	V4 2 dB	V5 1 dB	
Low	Low	Low	Low	Low	Reference I.L.
Low	Low	Low	Low	High	1 dB
Low	Low	Low	High	Low	2 dB
Low	Low	High	Low	Low	4 dB
Low	High	Low	Low	Low	8 dB
High	Low	Low	Low	Low	16 dB
High	High	High	High	High	31 dB Max. Atten.
Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.					

Control Voltage

State	Bias Condition
Low	0 to -3V @ 70 uA Typ.
High	Vee + 0.8V @ 5 uA Typ.
Note: Vee = -5V ± 10%	

Bias Voltage & Current

Vee Range = -5.0 Vdc ± 10%		
Vee (VDC)	Iee (Typ.) (mA)	Iee (Max.) (mA)
-5.0	3	6

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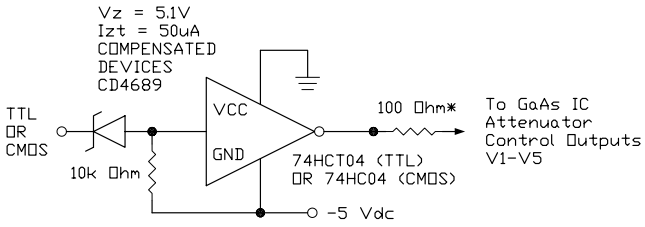
Suggested Driver Circuit

(One Circuit Required Per Bit Control Input)

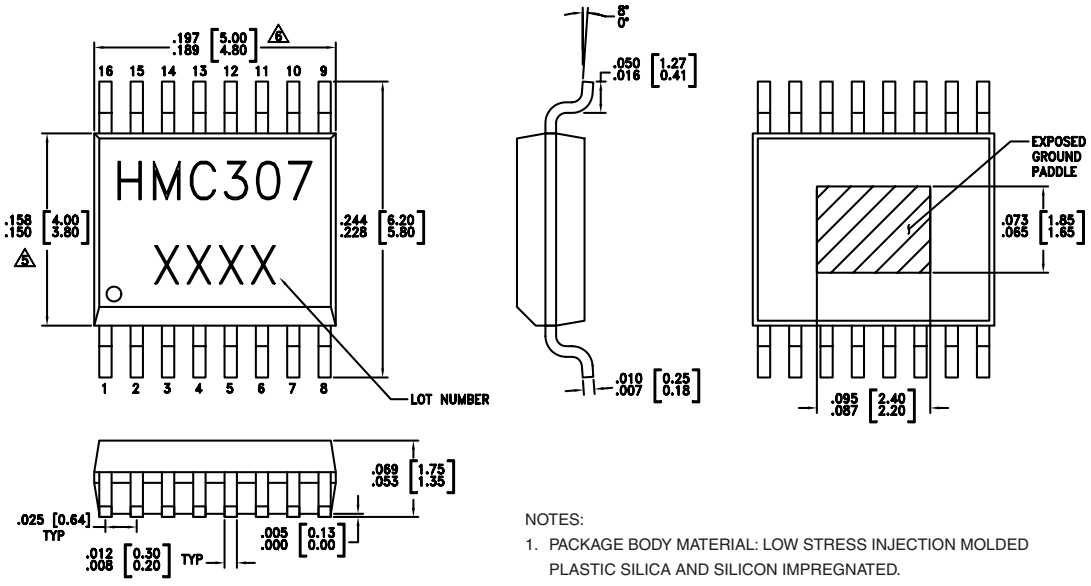


*Simple driver using inexpensive standard logic ICs provides fast switching using minimum DC current. * Recommended value to suppress unwanted RF signals at V1 - V5 control lines.*

Absolute Maximum Ratings

Control Voltage (V1 - V5)	Vee - 0.5 Vdc
Bias Voltage (Vee)	-7.0 Vdc
Storage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C
RF Input Power (0.5 - 4 GHz)	+26 dBm

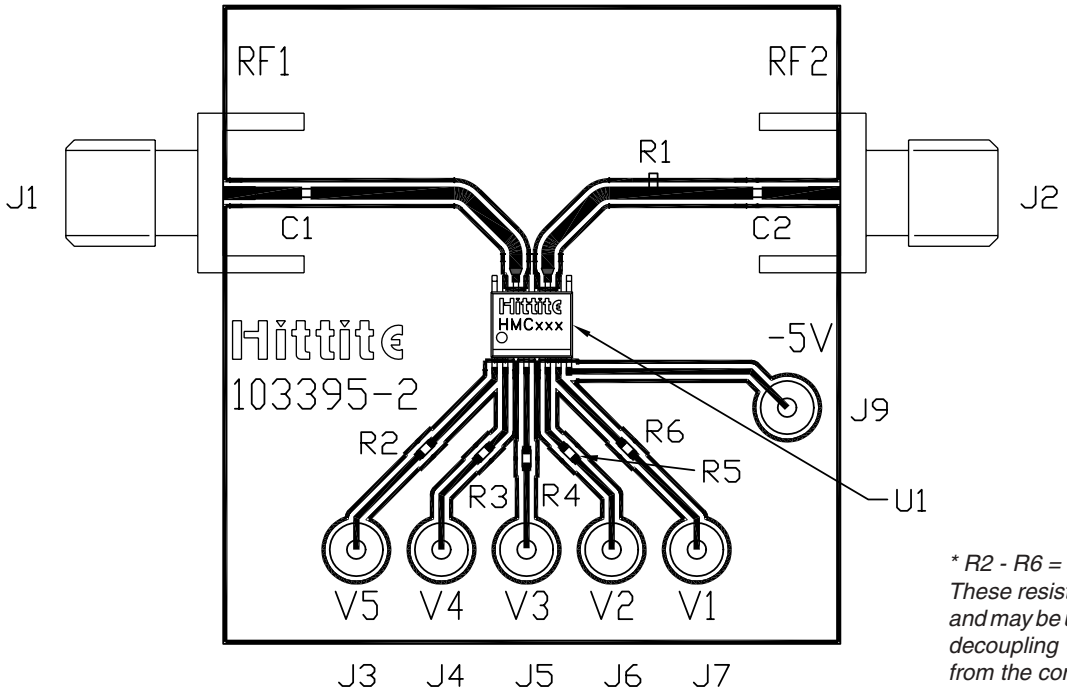
Outline Drawing



NOTES:

1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
2. LEADFRAME MATERIAL: COPPER ALLOY
3. LEADFRAME PLATING: Sn/Pb SOLDER
4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
5. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
6. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
7. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.

Evaluation Circuit Board



** R2 - R6 = 100 Ohm. These resistors are optional and may be used to enhance decoupling of the RF path from the control inputs.*

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 - J9	DC Pin
R1	5k Ohm Resistor, 0402 Pkg.
R2 - R6	100 Ohm Resistor, 0402 Pkg.
C1, C2	0402 Chip Capacitor, Select Value for Lowest Frequency of Operation
U1	HMC307QS16G Digital Attenuator
PCB*	103395 Evaluation PCB 1.5" x 1.5"
*Circuit Board Material: Rogers 4350	

Notes: