HMC274QS16

1 dB LSB GaAs IC 5-BIT DIGITAL ATTENUATOR, 0.7 - 2.7 GHz

Typical Applications

The HMC274QS16 is ideal for:

- Cellular/PCS/3G Infrastructure
- 2.4 GHz ISM Radios
- Wireless Data

Features

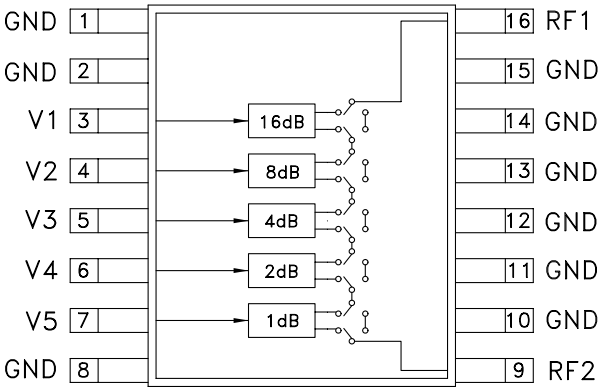
1 dB LSB Steps to 31 dB

Single Positive Control (+3 to +5V) Per Bit

+/- 0.5 dB Typical Bit Error

Small QSOP16 Plastic Package

Functional Diagram



General Description

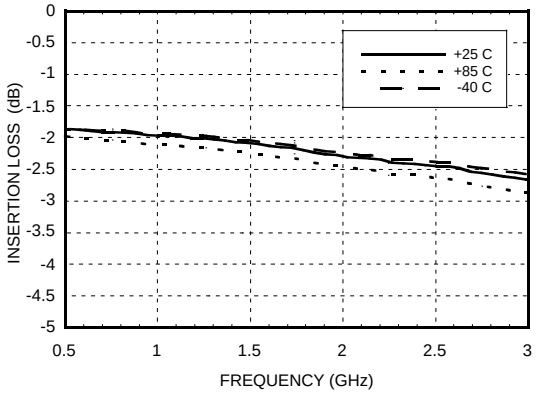
The HMC274QS16 is a broadband 5-bit positive control GaAs IC digital attenuator in a 16 lead QSOP plastic package. Covering 0.7 to 2.7 GHz the insertion loss is typically less than 2.3 dB. The attenuator bit values are 1 (LSB), 2, 4, 8, and 16 dB for a total attenuation of 31 dB. Accuracy is excellent at ± 0.5 dB typical with an IIP3 of up to +50 dBm. Five bit control voltage inputs, toggled between 0 and +3 to +5 volts, are used to select each attenuation state. A single Vdd bias of +3 to +5 volts applied through an external 5K Ohm resistor is required.

Electrical Specifications, T_A = +25° C, Vdd = +3V to +5V & Vctl = 0/Vdd

Parameter		Frequency	Min.	Typical	Max.	Units
Insertion Loss		0.7 - 1.4 GHz 1.4 - 2.3 GHz 2.3 - 2.7 GHz		2.0 2.3 2.5	2.4 2.7 3.1	dB dB dB
Attenuation Range		0.7 - 2.7 GHz		31		dB
Return Loss (RF1 & RF2, All Atten. States)		0.7 - 1.4 GHz 1.4 - 2.7 GHz	10 12	15 17		dB dB
Attenuation Accuracy: (Referenced to Insertion Loss) All Attenuation States All Attenuation States All Attenuation States		 0.7 - 1.4 GHz 1.4 - 2.3 GHz 2.3 - 2.7 GHz	 ± 0.35 + 5% of Atten. Setting Max ± 0.25 + 3% of Atten. Setting Max ± 0.30 + 5% of Atten. Setting Max			 dB dB dB
Input Power for 0.1 dB Compression	Vdd = 5V Vdd = 3V	0.7 - 2.7 GHz		29 20		dBm dBm
Input Third Order Intercept Point (Two-tone Input Power = 0 dBm Each Tone)	Vdd = 5V Vdd = 3V	0.7 - 2.7 GHz		54 52		dBm dBm
Switching Characteristics tRISE, tFALL (10/90% RF) tON, tOFF (50% CTL to 10/90% RF)		0.7 - 2.7 GHz		 560 600		 ns ns

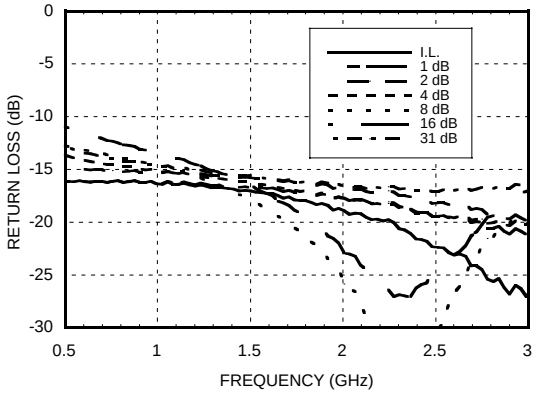
1 dB LSB GaAs IC 5-BIT DIGITAL ATTENUATOR, 0.7 - 2.7 GHz

Insertion Loss



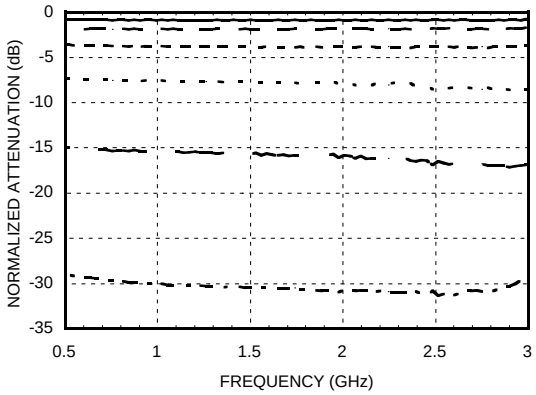
Return Loss RF1, RF2

(Only Major States are Shown)

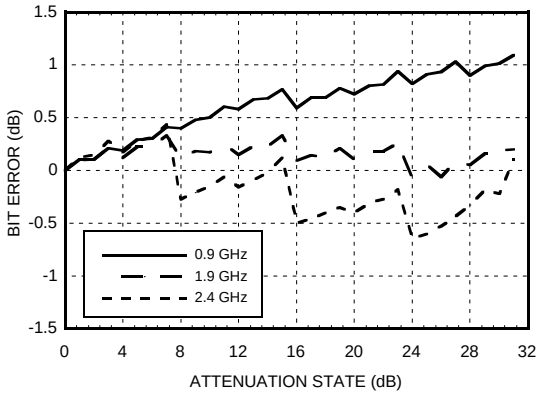


Normalized Attenuation

(Only Major States are Shown)

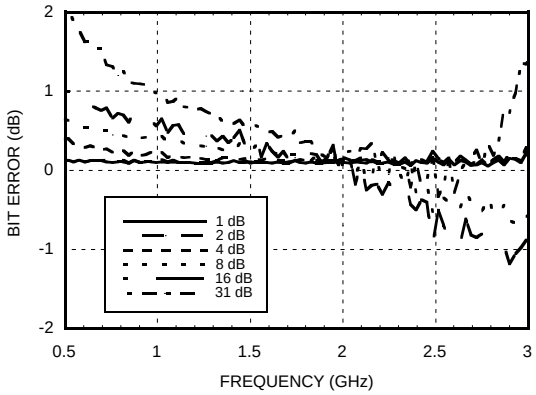


Bit Error vs. Attenuation State



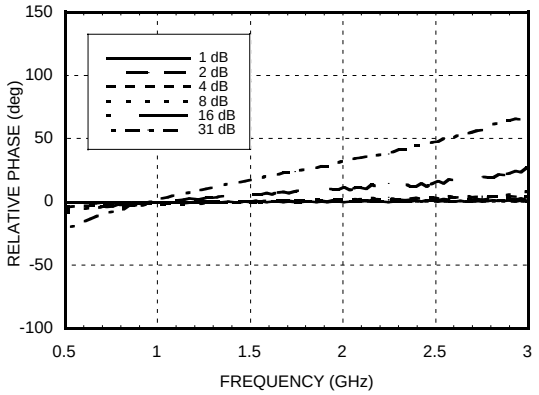
Bit Error vs. Frequency

(Only Major States are Shown)



Relative Phase vs. Frequency

(Only Major States are Shown)

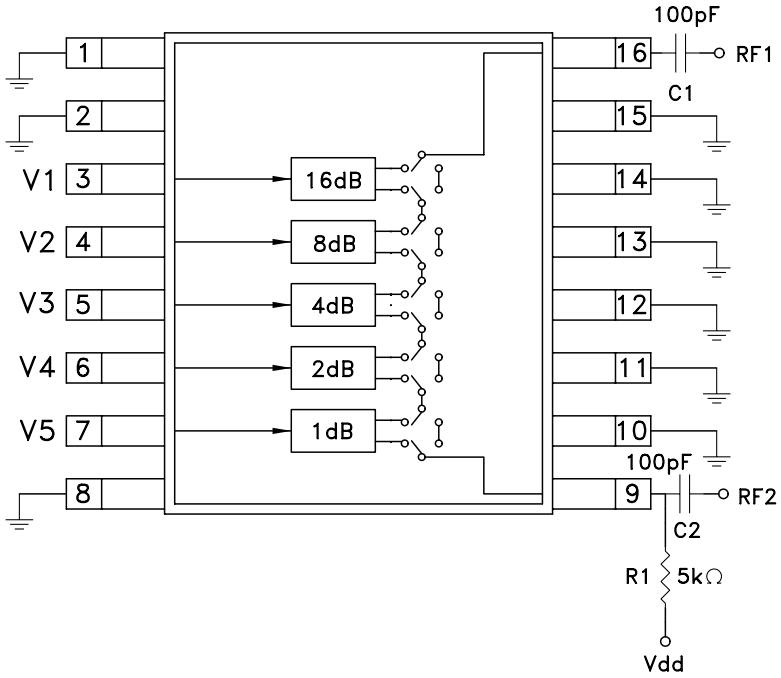


Note: All Data Typical Over Voltage (+3V to +5V).

Compression Point & IP3

Attenuation State (dB)	Control Voltage (V)	Input P1dB (dBm)			Input P0.1dB (dBm)			Input IP3 (dBm)		
		+25C	+85C	-40C	+25C	+85C	-40C	+25C	+85C	-40C
1	5	32.3	31.8	32.9	29.4	28.8	29.8	54.7	49.1	52.2
2	5	32.3	31.8	32.8	29.2	28.6	29.4	52.2	49.1	52.2
4	5	32.8	32.1	33.3	29.4	28.7	29.3	54.1	48.65	52.7
1	3	24.8	25.7	25.2	19.7	18.6	21.1	52.2	48.1	52.5
2	3	24.7	24.1	25.1	19.7	18.3	21.0	52.2	48.1	52.2
4	3	26.0	25.6	26.6	19.6	18.6	21.1	53.1	47.65	53.2

Application Circuit



DC blocking capacitors C1 & C2 are required on RF1 & RF2. Choose C1 = C2 = 100 ~ 300 pF 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 9 or PIN 16.

HMC274QS16

1 dB LSB GaAs IC 5-BIT DIGITAL ATTENUATOR, 0.7 - 2.7 GHz

Truth Table

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

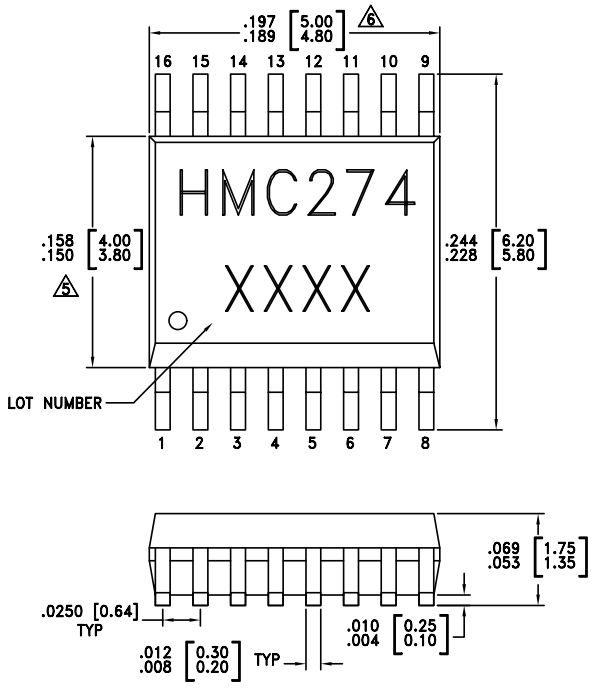
Control Voltages

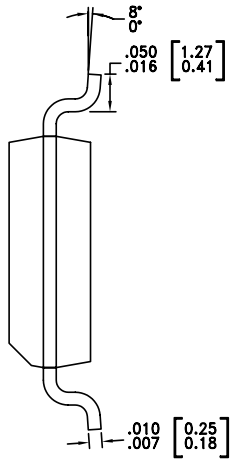
State	Bias Condition
Low	0 to +0.2 V @ 20 uA Max
High	Vdd ± 0.2V @ 100 uA Max
Note: Vdd = +3V to 5V ± 0.2V	

Absolute Maximum Ratings

Control Voltage (V1 - V5)	Vdd + 0.5 Vdc
Bias Voltage (Vdd)	+8.0 Vdc
Storage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C
RF Input Power (0.7 - 2.7 GHz)	+30 dBm

Outline Drawing

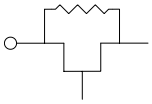
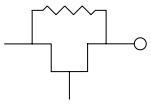




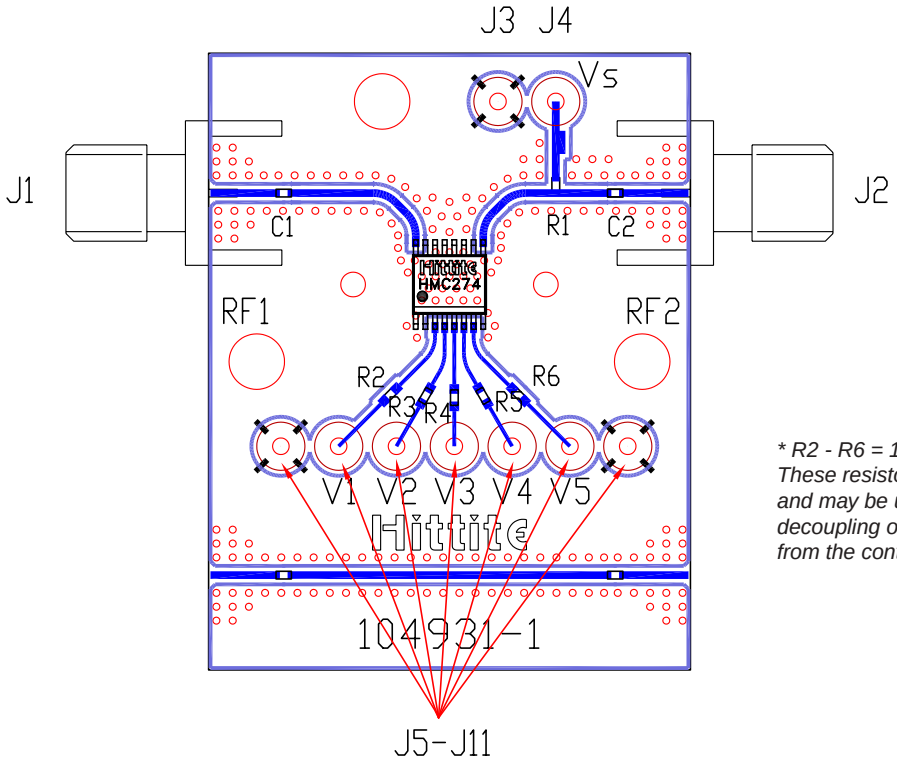
NOTES:

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 MUST BE SOLDERED TO PCB RF GROUND.

Pin Descriptions

Pin Number	Function	Description	Interface Schematic
1, 2, 8, 10 - 15	GND	This pin must be DC grounded.	
3 - 7	V1 - V5	See truth table and control voltage table.	
9	RF1	This pin is DC coupled and matched to 50 Ohm. Blocking capacitors are required.	
16	RF1	This pin is DC coupled and matched to 50 Ohm. Blocking capacitors are required.	

Evaluation PCB



** 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 should be connected directly to the ground plane similar to that shown below. A sufficient number of VIA holes should be used to connect the top and bottom ground planes. The evaluation circuit board as shown is available from Hittite Microwave Corporation upon request.

List of Material

Item	Description
J1 - J2	PC Mount SMA Connector
J3 - J11	DC Pin
R1	5k Ohm Resistor, 0402 Chip
R2 - R6	100 Ohm Resistor, 0402 Chip
C1, C2	0402 Chip Capacitor, Select for Lowest Frequency of Operation
U1	HMC274QS16 Digital Attenuator
PCB*	104931 Evaluation PCB
*Circuit Board Material: Rogers 4350	