HMC235QS16G

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

Typical Applications

The HMC235QS16G is ideal for:

- Cellular
- PCS, WLL, LMDS
- IF applications.

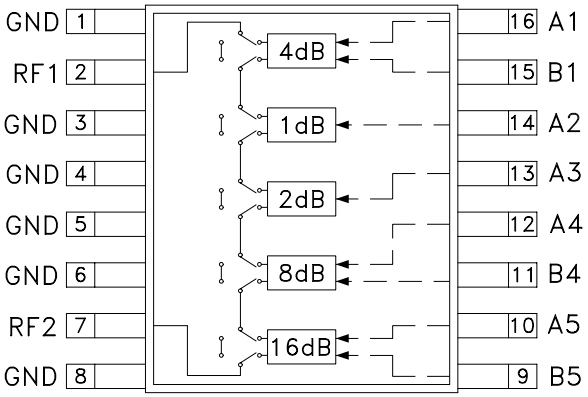
Features

Wide Bandwidth: DC - 4 GHz

Attenuation Bits: 1, 2, 4, 8, 16 dB

Miniature QSOP - 16 Package

Functional Diagram



General Description

The HMC235QS16G is a broadband 5-bit digital attenuator in a 16 - lead (narrow pitch) surface mount QSOP plastic package with an exposed ground slug. This package occupies the same area as an 8 lead SOIC package. The 1, 2, 4 and 8 dB bits have less than 10 degrees relative phase shift. The five primary attenuation states can be activated independently, or collectively for attenuation levels of 1 to 31 dB.

Electrical Specifications, T_A = +25° C, With 0/-5V Control

Parameter		Frequency	Min.	Typical	Max.	Units
Insertion Loss		DC - 2 GHz 2 - 4 GHz		5.0 5.3	5.4 6.0	dB dB
Attenuation Range		DC - 4 GHz	25	31		dB
Input Return Loss (All States)		DC - 2 GHz 2 - 4 GHz	7 4	12 7		dB dB
Output Return Loss (All States)		DC - 2 GHz 2 - 4 GHz	10 7	18 11		dB dB
Attenuation Accuracy:	1 dB Bit 2 dB Bit 4 dB Bit 8 dB Bit 16 dB Bit All Bits (31 dB)	0.1 - 2 GHz	0.5 1.4 3.2 7.0 14.0 26.0	1 2 4 8 16 31	1.5 2.6 4.8 9.0 17.9 35.0	dB dB dB dB dB dB
Attenuation Accuracy:	1 dB Bit 2 dB Bit 4 dB Bit 8 dB Bit 16 dB Bit All Bits (31 dB)	2 - 4 GHz	0.5 1.3 3.2 7.0 14.0 25.0	1 2 4 8 16 31	1.5 2.7 4.8 9.0 17.9 35.0	dB dB dB dB dB dB
Switching Characteristics	tRISE, tFALL (10/90% RF) tON, tOFF (50% CTL to 10/90% RF)	DC - 4 GHz		3 6		ns ns
Input Power for 0.2 dB Compression		0.05 GHz Min. Atten. State 0.05 GHz All Atten. States 0.5 - 4 GHz Min. Atten. State 0.5 - 4 GHz All Atten. States	8 7 18 7	12 11 24 12		dBm dBm dBm dBm
Input Third Order Intercept Point Two-tone Input Power = +5 dBm Each Tone		0.05 GHz Min. Atten. State 0.05 GHz All Atten. States 0.5 - 4 GHz Min. Atten. State 0.5 - 4 GHz All Atten. States	24 23 38 22	28 30 44 32		dBm dBm dBm dBm

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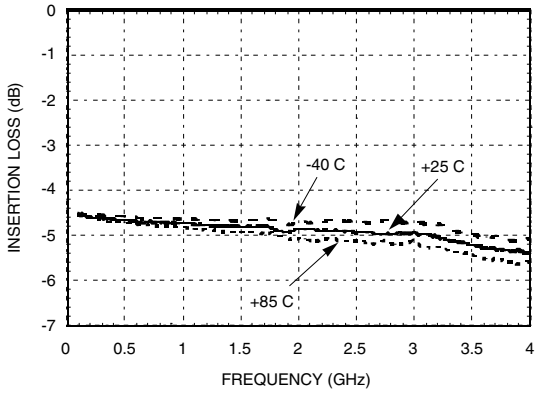
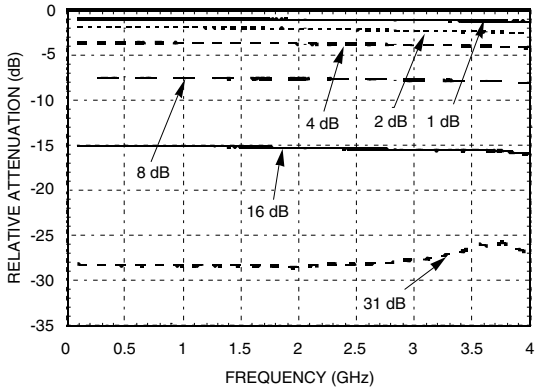
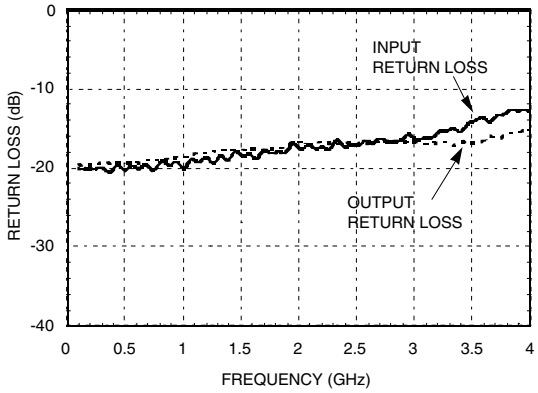
Insertion Loss



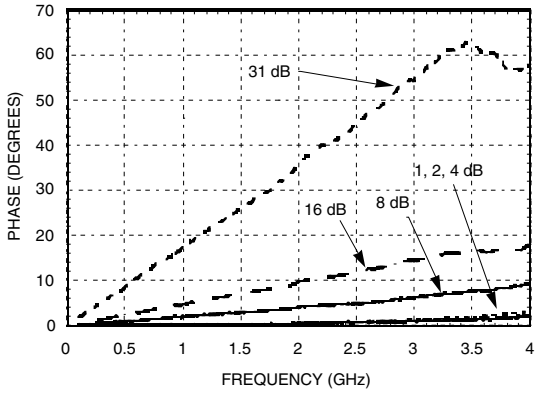
Relative Attenuation



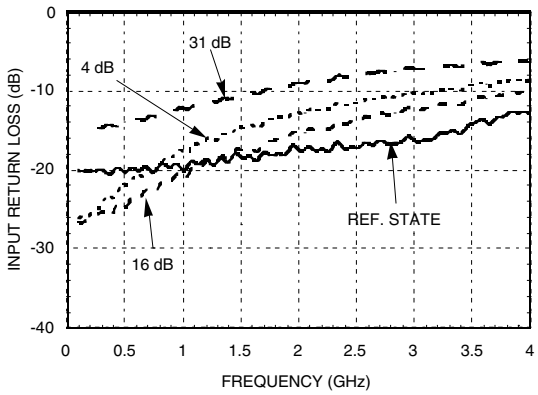
Return Loss (Reference State)



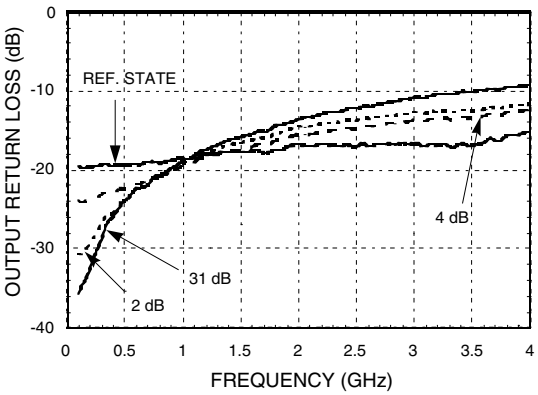
Relative Phase



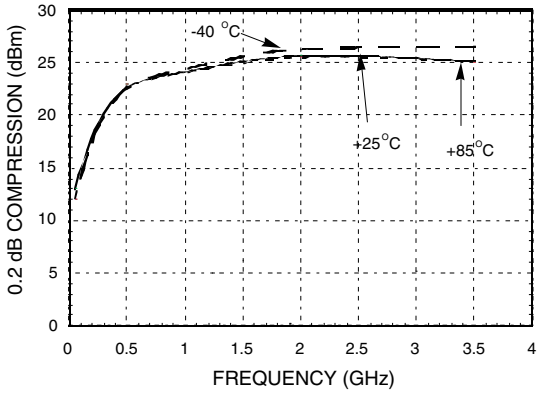
Input Return Loss



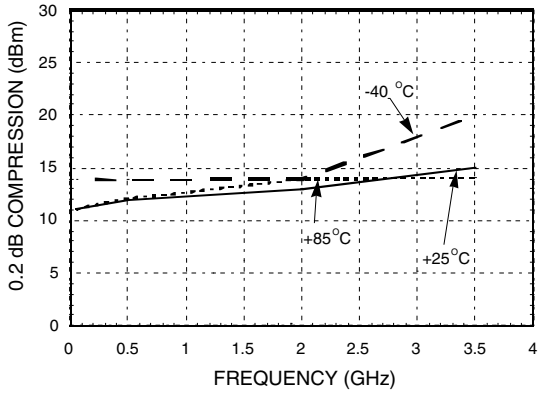
Output Return Loss



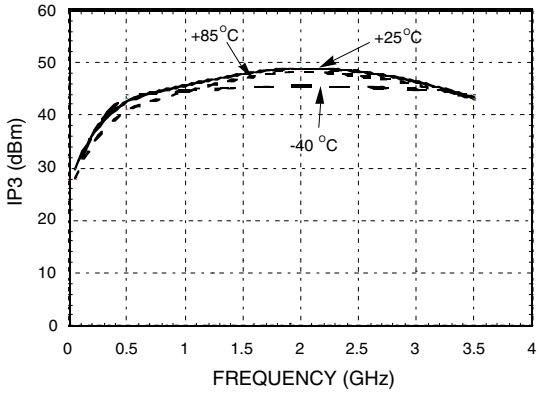
Input Power for 0.2 dB Compression
(Minimum Attenuation)



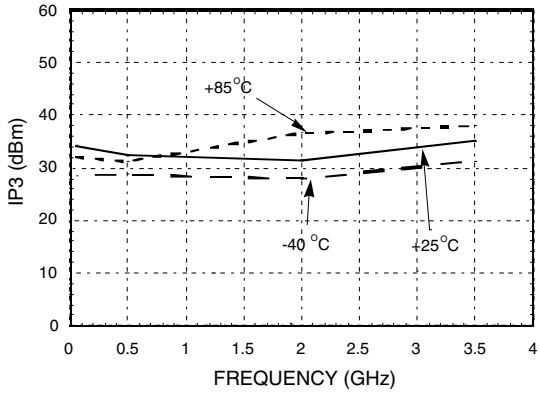
Input Power for 0.2 dB Compression
(Maximum Attenuation)



IP3 *(Minimum Attenuation)*



IP3 *(Maximum Attenuation)*



For price, delivery, and to place orders, please contact Hittite Microwave Corporation:
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Visit us at www.hittite.com, or Email at sales@hittite.com

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Control Voltages

State	Bias Condition
Low	0 to -0.2 V @ 20 uA Max
High	-3V @ 50 uA Typ to -8V @ 500 uA Max

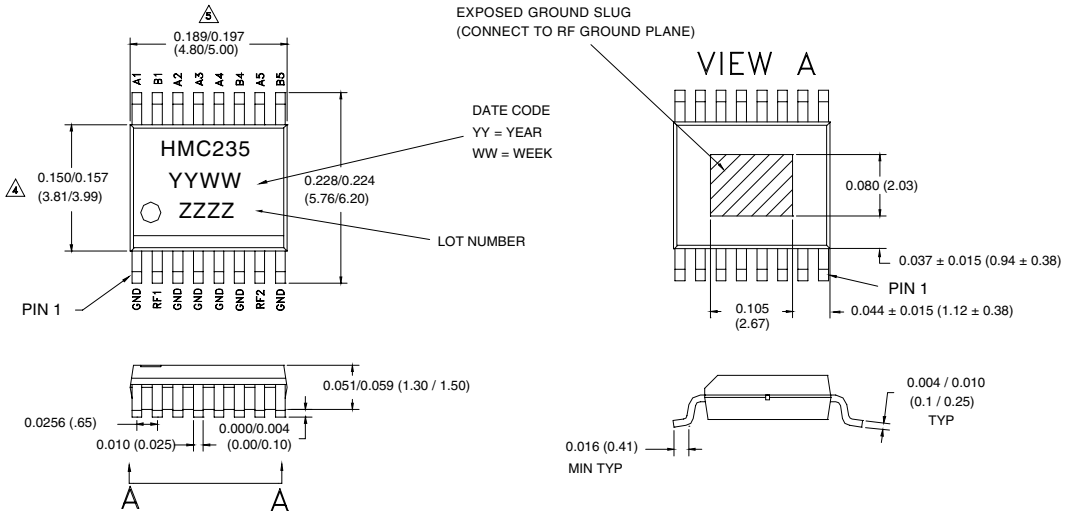
Absolute Maximum Ratings

Control Voltage Range	+0.5 to +8.5 Vdc
Storage Temperature	-65 to +150 deg C
Operating Temperature	-40 to +85 deg C
RF Input Power (0.5 - 4 GHz) Insertion Loss State Any Attenuation State	 +27 dBm +13 dBm

Truth Table

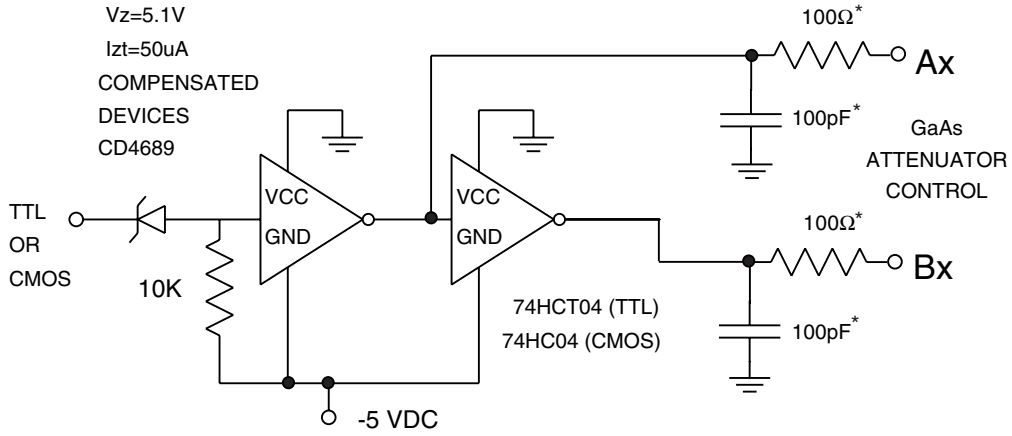
Control Input								Att Set
4 dB Bit		1 dB	2 dB	8 dB Bit		16 dB Bit		
A!	B1	A2	A3	A4	B4	A5	B5	
High	Low	High	High	High	Low	High	Low	Ref
High	Low	Low	High	High	Low	High	Low	1dB
High	Low	High	Low	High	Low	High	Low	2dB
Low	High	High	High	High	Low	High	Low	4dB
High	Low	High	High	Low	High	High	Low	8dB
High	Low	High	High	High	Low	Low	High	16dB
Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.								

Outline Drawing



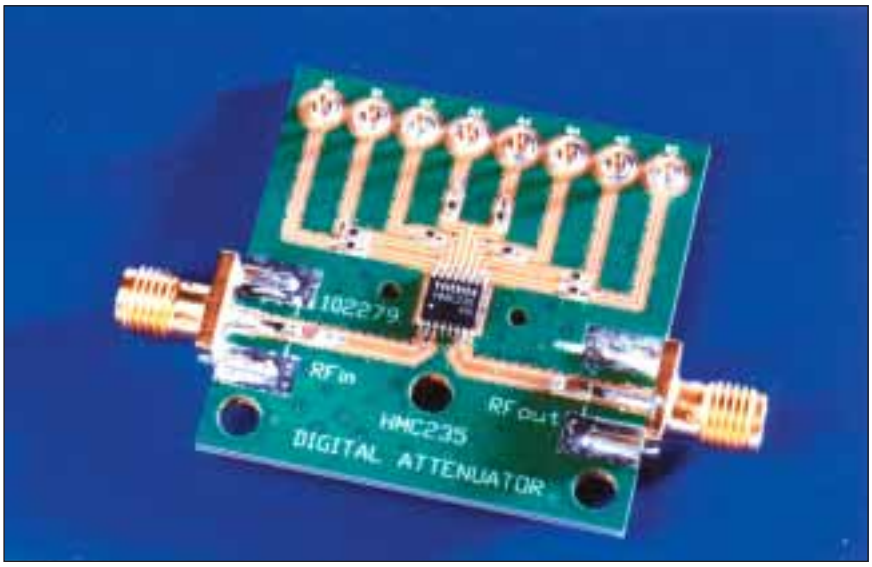
1. MATERIAL:
   A) PACKAGE BODY - LOW STRESS INJECTION - MOLDED PLASTIC.
   B) LEADFRAME AND SLUG MATERIAL: COPPER ALLOY.
2. PLATING: LEAD-TIN SOLDER PLATE.
3. DIMENSIONS ARE IN INCHES (MILLIMETERS), UNLESS OTHERWISE SPECIFIED TOL. ARE ±0.005 (±0.13).
4. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
5. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.

Suggested Driver Circuit



Simple driver using inexpensive standard logic ICs provides fast switching using minimum DC current.
*Recommended values to suppress unwanted RF signals at Ax/Bx control lines. Component values may be adjusted for switching speed considerations.

Evaluation Circuit Board



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. 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.

Evaluation Circuit Board Layout Design Details

Layout Technique	Ground Co-Planar Waveguide (GCPW)
Material	Rogers 4350
Dielectric Thickness	0.020" (0.51 mm)
50 Ohm Line Width	0.034" (0.86 mm)
Gap to Ground Edge	0.010" (0.25 mm)
Ground VIA Hole Diameter	0.014" (0.36 mm)
Connectors	SMA-F (EF - Johnson P/N 142-0701-806)