HMC235QS16G

GaAs MMIC SMT 5 - BIT DIGITAL ATTENUATOR DC - 4 GHz

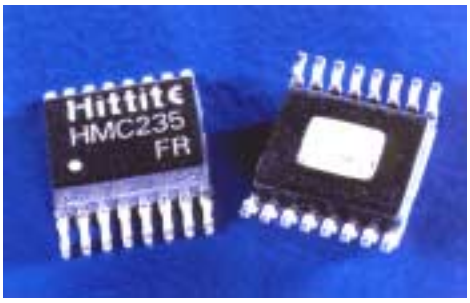
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Features

WIDE BANDWIDTH: DC - 4 GHz

ATTENUATION BITS: 1, 2, 4, 8, 16 dB

MINIATURE QSOP-16 PACKAGE



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. The HMC235QS16G is ideal for cellular, PCS, WLL, LMDS and IF applications.This is the smallest 5 bit digital attenuator available.

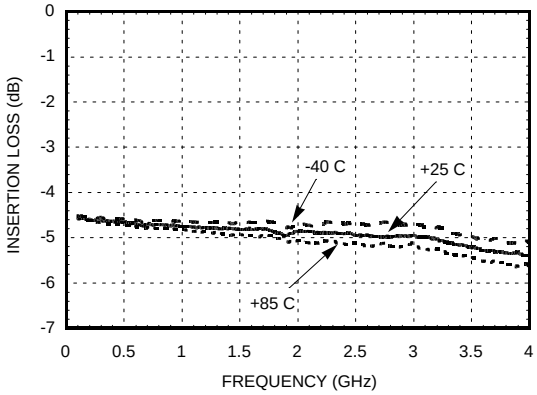
Guaranteed Performance *With 0/-5V Control, -40 to +85 deg C*

Parameter	Frequency	Min.	Typ.	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%) 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 each tone = +5dBm typ.	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

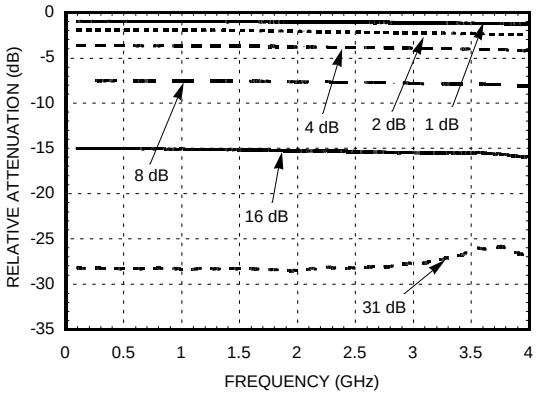
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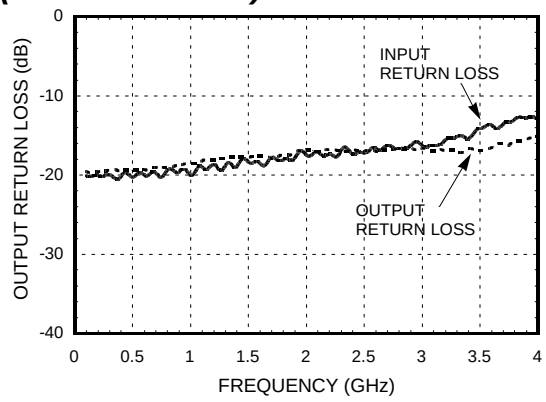
Insertion Loss



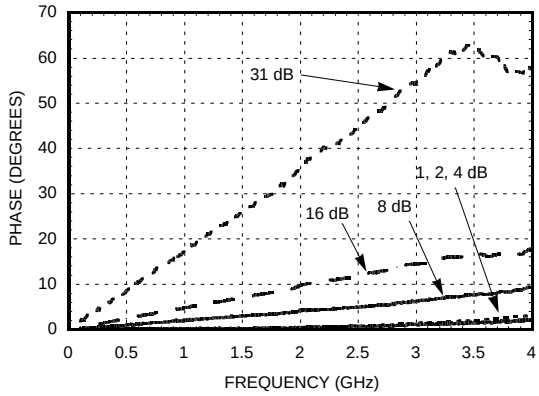
Relative Attenuation



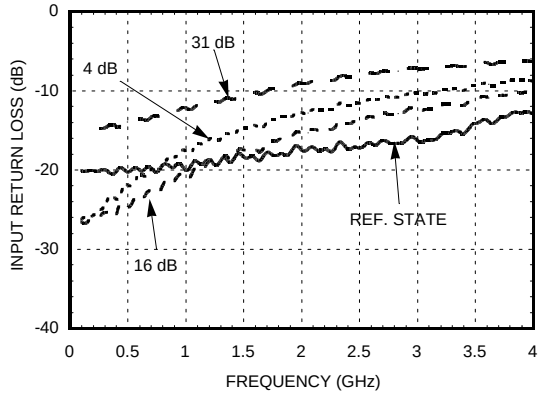
Input + Output Return Loss (Reference State)



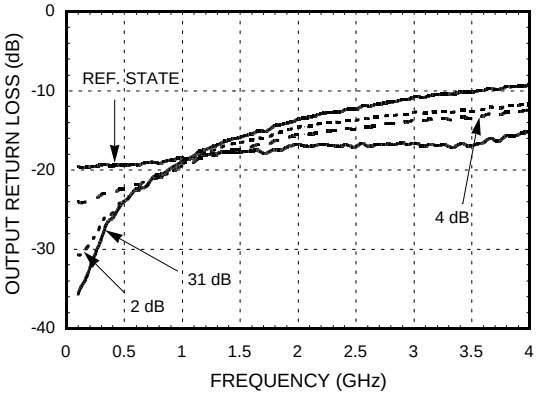
Relative Phase



Input Return Loss



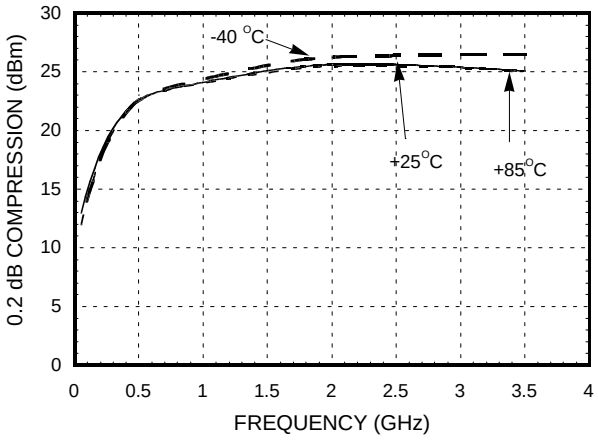
Output Return Loss



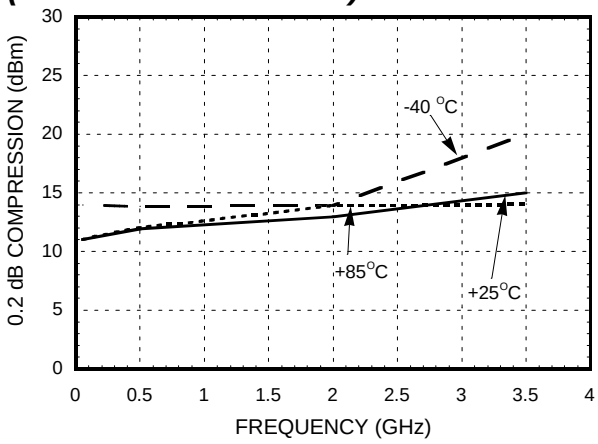
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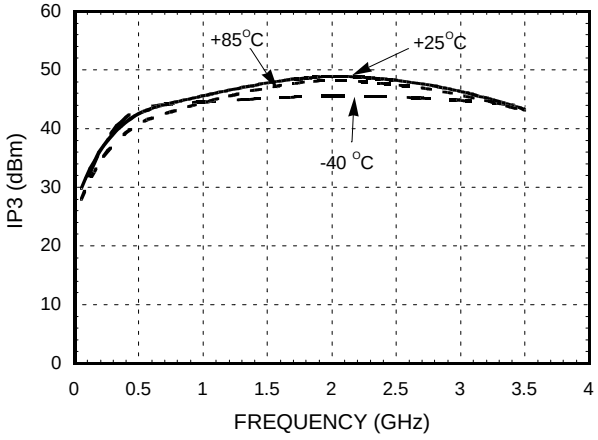
Input Power for 0.2 dB Compression (Minimum Attenuation)



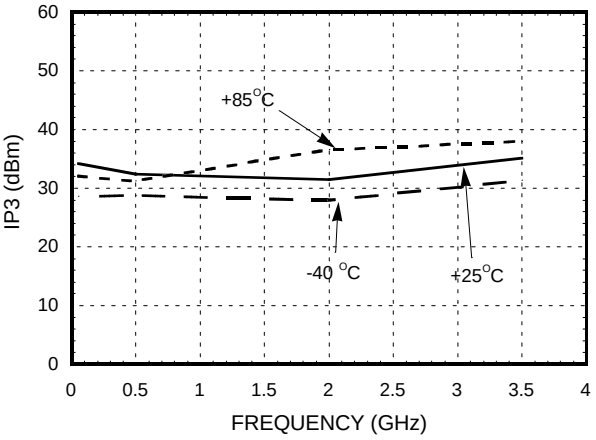
Input Power for 0.2 dB Compression (Maximum Attenuation)



IP3 (Minimum Attenuation)



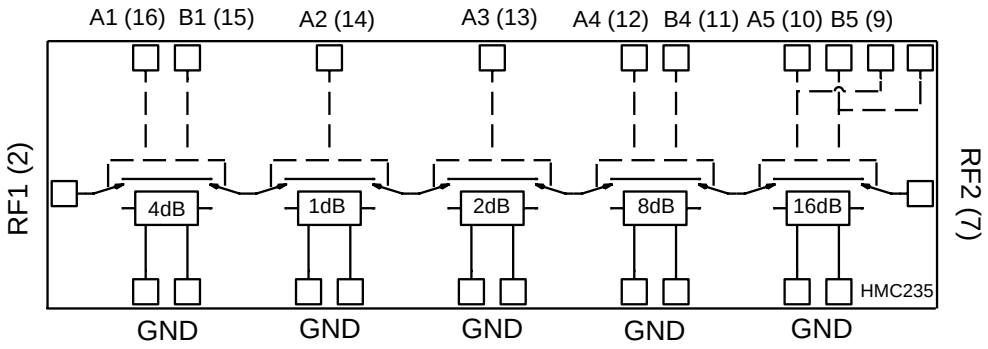
IP3 (Maximum Attenuation)



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Schematic



Pins 1, 3 - 6 and 8 are GND.

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

Control Voltages

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

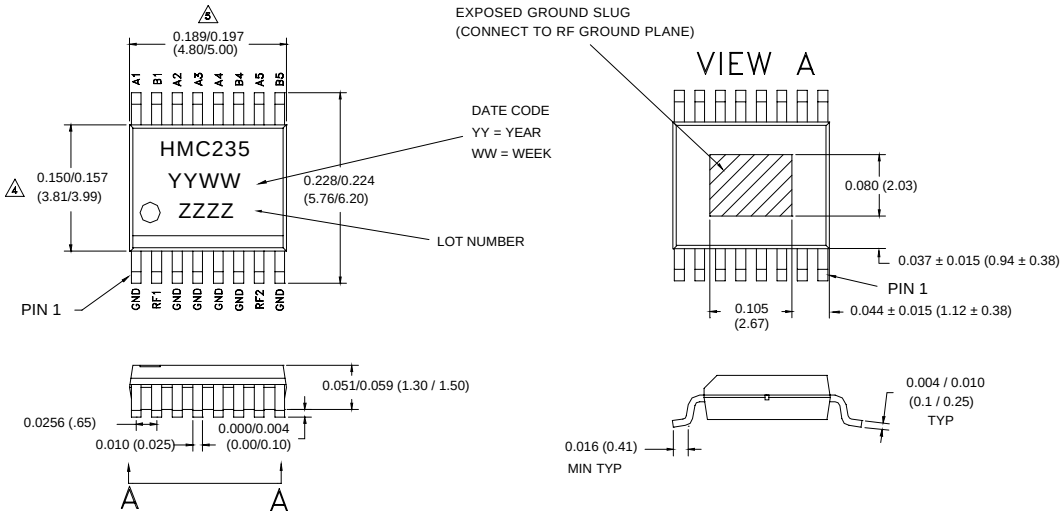
Truth Table

Control Input								Att Set
4 dB Bit		1dB	2dB	8dB Bit		16dB Bit		
A1	B1	A2	A3	A4	B4	A5	B5	
Hi	Lo	Hi	Hi	Hi	Lo	Hi	Lo	Ref
Hi	Lo	Lo	Hi	Hi	Lo	Hi	Lo	1dB
Hi	Lo	Hi	Lo	Hi	Lo	Hi	Lo	2dB
Lo	Hi	Hi	Hi	Hi	Lo	Hi	Lo	4dB
Hi	Lo	Hi	Hi	Lo	Hi	Hi	Lo	8dB
Hi	Lo	Hi	Hi	Hi	Lo	Lo	Hi	16dB
Any combination of above states will provide an attenuation approximately equal to the sum of the bits selected.								

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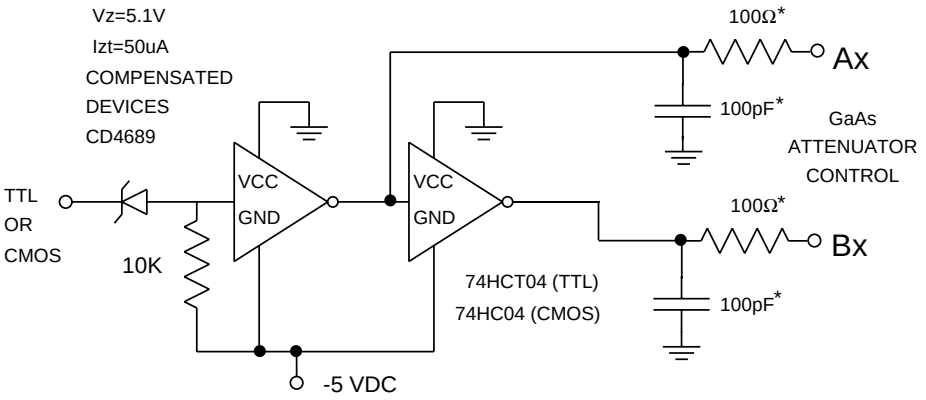
Outline



1. MATERIAL:
   A) PACKAGE BODY - LOW STRESS INJECTION-MOLDED PLASTIC.
   B) LEADFRAME AND SLUG MATERIAL: COPPER ALLOY
2. PLATING : LEAD - TIN SOLDER PLATE (LEAD AND SLUG)
3. DIMENSIONS ARE IN INCHES (MILLIMETERS).
   UNLESS OTHERWISE SPECIFIED ALL TOL. ARE ±0.005(±0.13).

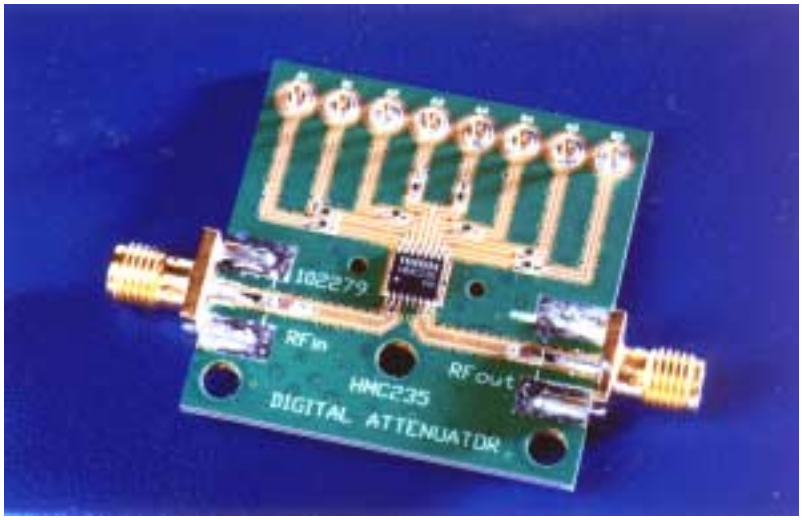
4. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15 MM PER SIDE
5. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25 MM PER SIDE

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 above. 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 upon request.

Evaluation Circuit Board Layout Design Details

Layout Technique	Grounded 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)