

# Analog Devices Welcomes Hittite Microwave Corporation

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## 1 dB LSB GaAs MMIC 5-BIT DIGITAL ATTENUATOR, 0.7 - 3.8 GHz

### Typical Applications

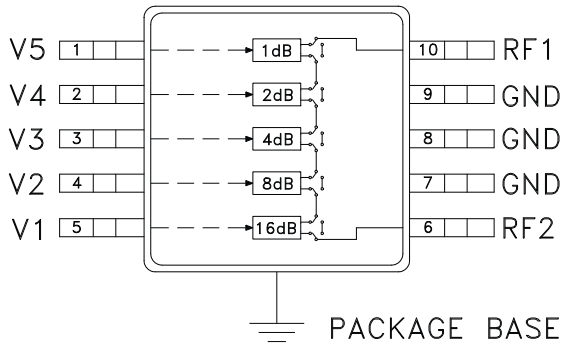
The HMC273MS10G(E) is ideal for:

- Cellular; UMTS/3G Infrastructure
- ISM, MMDS, WLAN, WiMAX
- Microwave Radio & VSAT
- Test Equipment and Sensors

### Features

- RoHs Compliant Product
- 1 dB LSB Steps to 31 dB
- Single Positive Control Per BIT
- ±0.2 dB Typical Bit Error
- Miniature MSOP 10 Package: 14.8mm<sup>2</sup>
- Included in the HMC-DK004 Designer's Kit

### Functional Diagram



### General Description

The HMC273MS10G(E) is a general purpose broadband 5-Bit positive control GaAs IC digital attenuator in a 10 lead MSOP plastic package. Covering 0.7 to 3.8 GHz, the insertion loss is typically less than 2.5 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 ±0.2 dB typical with an IIP3 of up to +48 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,

$T_A = +25^\circ C$ ,  $V_{dd} = +3V$  to  $+5V$  &  $V_{ctl} = 0/V_{dd}$  (Unless Otherwise Stated)

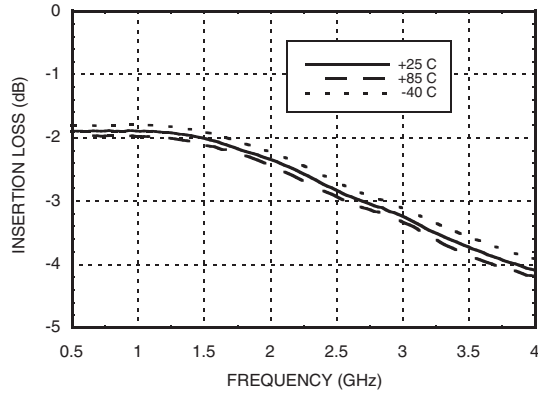
Parameter	Frequency	Min.	Typical	Max.	Units
Insertion Loss	0.7 - 1.4 GHz		1.8	2.4	dB
	1.4 - 2.3 GHz		2.3	2.9	dB
	2.3 - 2.7 GHz		2.8	3.4	dB
	2.7 - 3.7 GHz		3.5	4.2	dB
	3.7 - 3.8 GHz		3.9	4.4	dB
Attenuation Range	0.7 - 3.8 GHz		31		dB
Return Loss (RF1 & RF2, All Atten. States)	0.7 - 1.4 GHz	11	17		dB
	1.4 - 2.7 GHz	12	20		dB
	2.7 - 3.8 GHz	10	14		dB
Attenuation Accuracy: (Referenced to Insertion Loss) All Attenuation States All Attenuation States All Attenuation States All Attenuation States	0.7 - 1.4 GHz	± (0.30 + 3% of Atten. Setting) Max			dB
	1.4 - 2.2 GHz	± (0.30 + 4% of Atten. Setting) Max			dB
	2.2 - 2.7 GHz	± (0.40 + 5% of Atten. Setting) Max			dB
	2.7 - 3.8 GHz	± (0.50 + 5% of Atten. Setting) Max			dB
Input Power for 0.1 dB Compression	0.7 - 3.8 GHz	Vdd = 5V	27		dBm
		Vdd = 3V	22		dBm
Input Third Order Intercept Point (Two-tone Input Power = 0 dBm Each Tone)	0.7 - 3.8 GHz	Vdd = 5V	48		dBm
		Vdd = 3V	46		dBm
Switching Characteristics tRISE, tFALL (10/90% RF) tON, tOFF (50% CTL to 10/90% RF)	0.7 - 3.8 GHz		560		ns
			600		ns



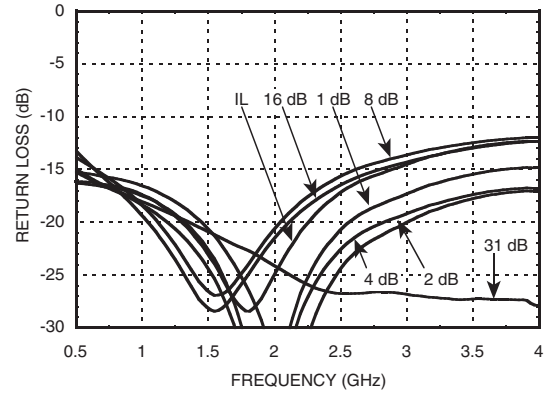
# HMC273MS10G / 273MS10GE

## 1 dB LSB GaAs MMIC 5-BIT DIGITAL ATTENUATOR, 0.7 - 3.8 GHz

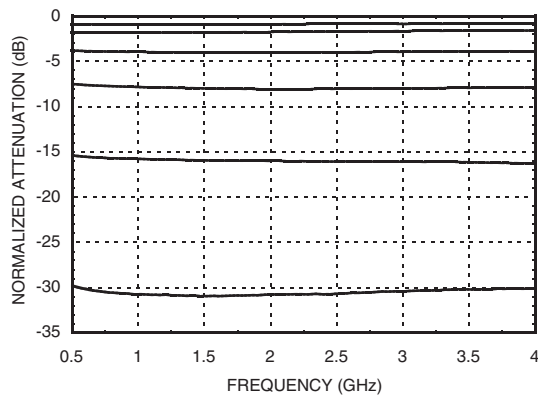
**Insertion Loss vs. Temperature**



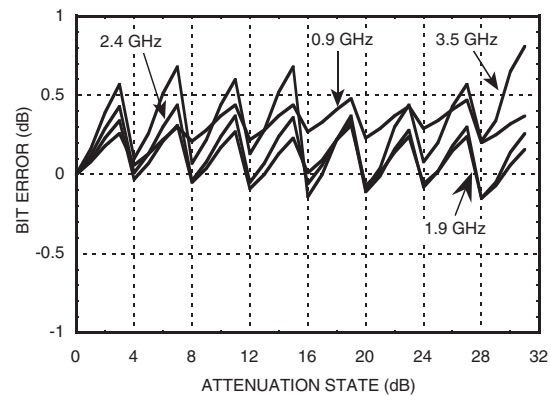
**Return Loss RF1, RF2**  
(Only Major States are Shown)



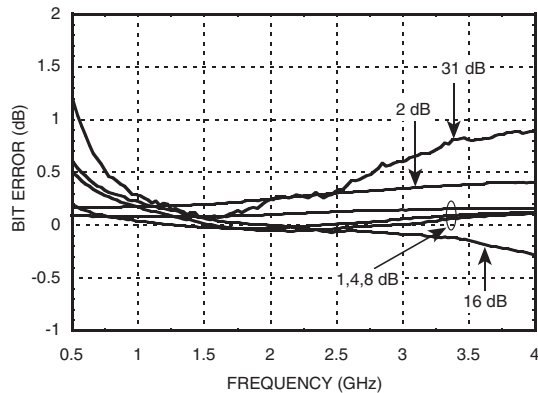
**Normalized Attenuation**  
(Only Major States are Shown)



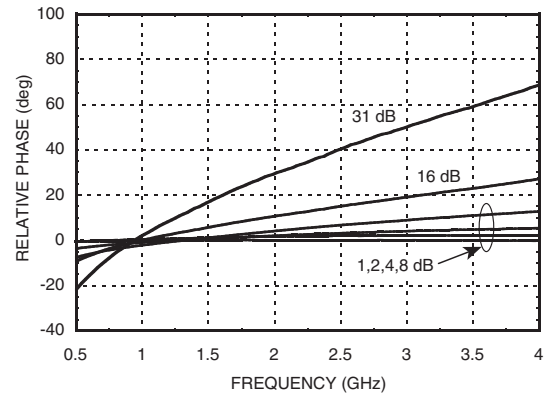
**Bit Error vs. Attenuation State**



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



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

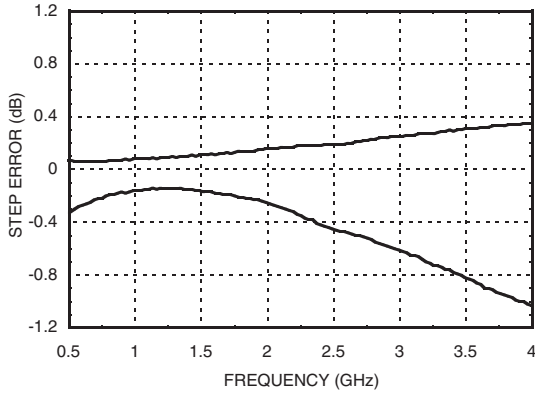


Note: All Data Typical Over Voltage (+3V to +5V)

For price, delivery, and to place orders, please contact Hittite Microwave Corporation:  
20 Alpha Road, Chelmsford, MA 01824 Phone: 978-250-3343 Fax: 978-250-3373  
Order On-line at [www.hittite.com](http://www.hittite.com)



### Worst Case Step Error Between Successive Attenuation States



### 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.

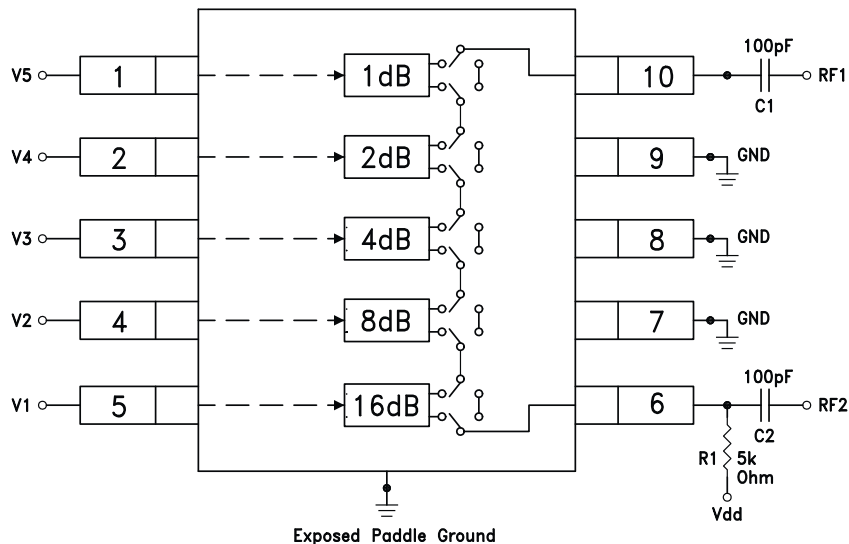
Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

### 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

### 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 6 or PIN 10.

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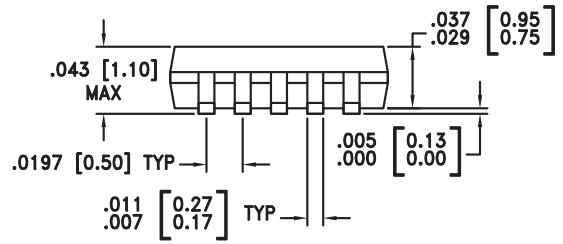
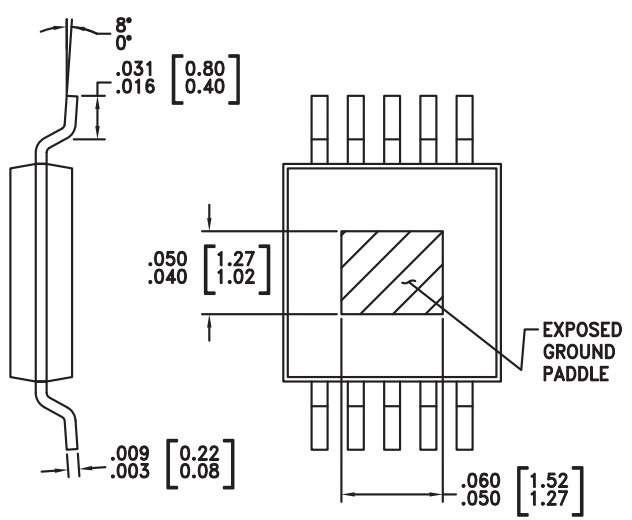
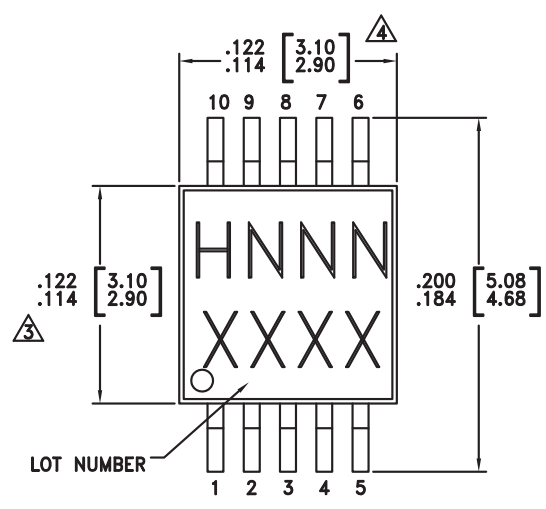
### Absolute Maximum Ratings

Control Voltage (V1 - V5)	Vdd + 0.5 Vdc
Bias Voltage (Vdd)	+8.0 Vdc
Channel Temperature	150 °C
Continuous P <sub>diss</sub> (T=85°C) (derate 6mW/°C above 85°C)	0.4 W
Thermal Resistance	163 °C/W
Storage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C
RF Input Power (0.7 - 3.7 GHz)	+30 dBm
ESD Sensitivity (HBM)	Class 1A



ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS

### Outline Drawing



- NOTES:
- LEADFRAME MATERIAL: COPPER ALLOY
  - DIMENSIONS ARE IN INCHES [MILLIMETERS].
  - $\triangle$  DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
  - $\triangle$  DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
  - ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.

### Package Information

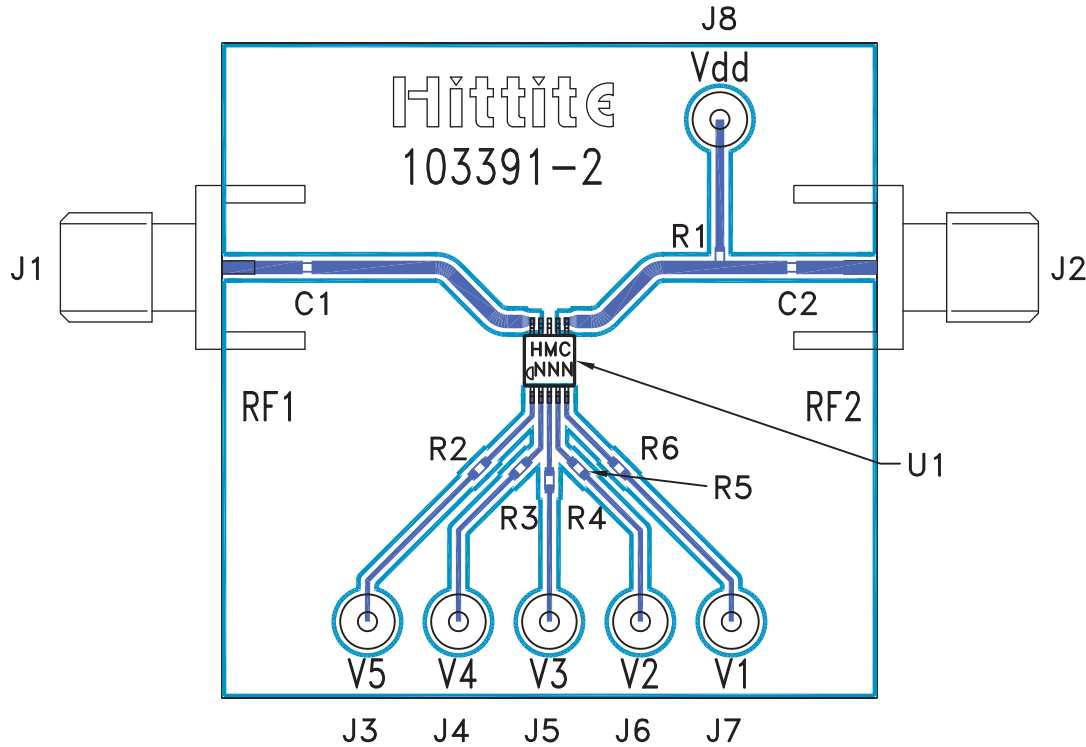
Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking <sup>[3]</sup>
HMC273MS10G	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL1 <sup>[1]</sup>	H273 XXXX
HMC273MS10GE	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 <sup>[2]</sup>	H273 XXXX

[1] Max peak reflow temperature of 235 °C  
 [2] Max peak reflow temperature of 260 °C  
 [3] 4-Digit lot number XXXX

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### 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.

### List of Materials for Evaluation PCB 103393 [1]

Item	Description
J1 - J2	PCB Mount SMA Connector
J3 - J6	DC Pin
R1	5k Ohm Resistor, 0402 Chip
R2, R3, R4	100 Ohm Resistor, 0402 Chip
C1, C2	0402 Chip Capacitor, Select for Lowest Frequency of Operation
U1	HMC273MS10G / HMC273MS10GE Digital Attenuator
PCB [2]	103391 Evaluation PCB 1.5" x 1.5"

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

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 ground paddle 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.



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## HMC273MS10G / 273MS10GE

**1 dB LSB GaAs MMIC 5-BIT DIGITAL  
ATTENUATOR, 0.7 - 3.8 GHz**

**Notes:**

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ATTENUATORS - SMT