HMC288MS8 / 288MS8E

2 dB LSB GaAs MMIC 3-BIT DIGITAL ATTENUATOR, 0.7 - 3.7 GHz

v01.0705

Typical Applications

The HMC288MS8 / HMC288MS8E is ideal for:

- Cellular
- PCS, ISM, MMDS
- WLL applications

Features

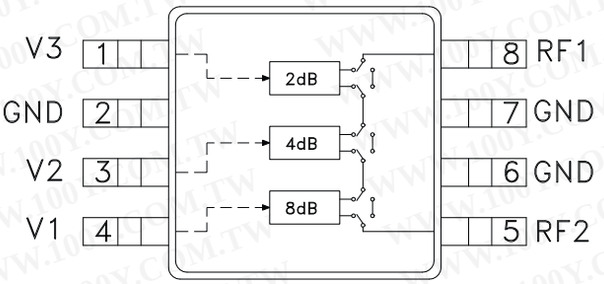
2 dB LSB Steps to 14 dB

Single Positive Control Per BIT

Monotonic: ±03 dB Bit Error Typical

Miniature MSOP-8 Package, 14.8mm²

Functional Diagram



General Description

The HMC288MS8 & HMC288MS8E are broadband 3-bit positive control GaAs IC digital attenuators in 8 lead MSOP surface mount plastic packages. Covering 0.7 to 3.7 GHz, the insertion loss is typically less than 1.2 to 1.8 dB. The attenuator bit values are 2 (LSB), 4, and 8 dB for a total attenuation of 14 dB. Accuracy is excellent at ± 0.3 dB typical with an IIP3 of up to +51 dBm. Three bit control voltage inputs, toggled between 0 and +3 to +5V, are used to select each attenuation state at less than 50 uA each. A single Vdd bias of +3 to +5V applied through an external 5K Ohm resistor is required while occupying less than 14.8 mm².

Electrical Specifications, T_A = +25° C, Vdd = +3V to +5V & Vctl = 0/Vdd (Unless Otherwise Stated)

Parameter		Frequency	Min.	Typical	Max.	Units
Insertion Loss		0.7 - 1.4 GHz 1.4 - 2.3 GHz 2.3 - 2.7 GHz 2.7 - 3.7 GHz		1.0 1.3 1.5 1.7	1.4 1.7 2.0 2.3	dB dB dB dB
Attenuation Range		0.7 - 3.7 GHz		14		dB
Return Loss (RF1 & RF2, All Atten. States)		0.7 - 1.4 GHz 1.4 - 2.3 GHz 2.3 - 2.7 GHz 2.7 - 3.7 GHz	14 11 10 9	17 15 14 12		dB dB dB dB
Attenuation Accuracy: (Referenced to Insertion Loss)						
All Attenuation States All Attenuation States All Attenuation States All Attenuation States		0.7 - 1.4 GHz 1.4 - 2.3 GHz 2.3 - 2.7 GHz 2.7 - 3.7 GHz	± 0.3 + 3% of Atten. Setting Max ± 0.2 + 3% of Atten. Setting Max ± 0.3 + 3% of Atten. Setting Max ± 0.3 + 4% of Atten. Setting Max			dB dB dB dB
Input Power for 0.1 dB Compression	5V 3V	0.7 - 3.7 GHz		25 22		dBm dBm
Input Third Order Intercept Point (Two-tone Input Power = 0dBm Each Tone)	5V 3V	0.7 - 3.7 GHz		51 47		dBm dBm
Switching Characteristics tRISE, tFALL (10/90% RF) tON, tOFF (50% CTL to 10/90% RF)		0.7 - 3.7 GHz		560 600		ns ns

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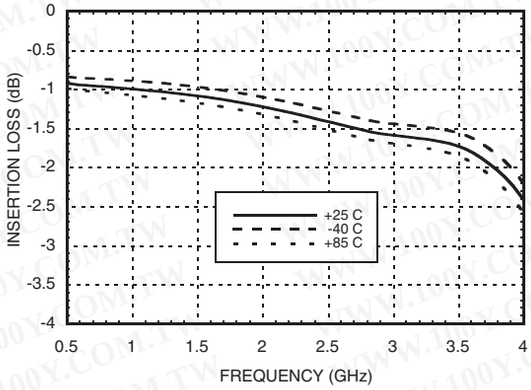
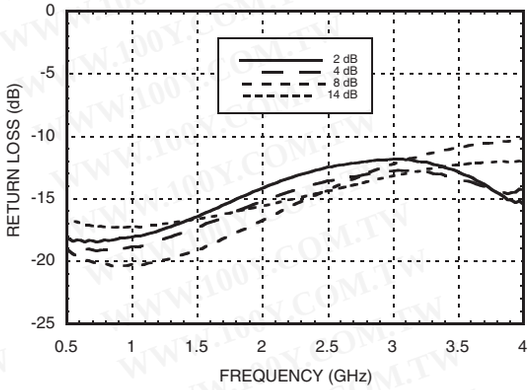
Insertion Loss



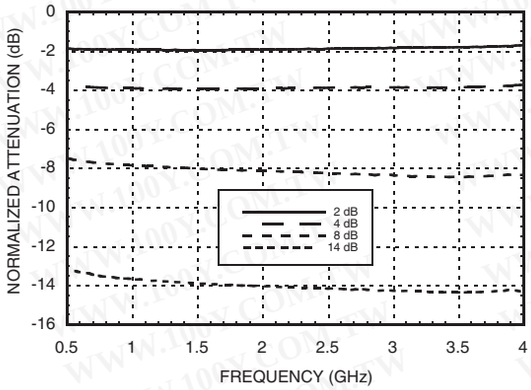
Return Loss RF1, RF2

(Only Major States are Shown)

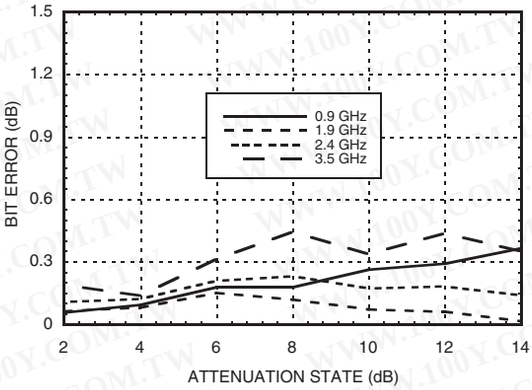


Normalized Attenuation

(Only Major States are Shown)

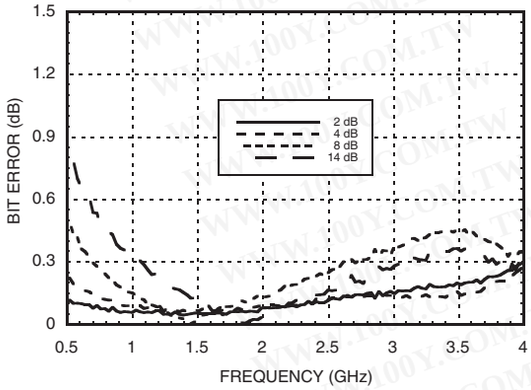


Absolute Bit Error vs. Attenuation State



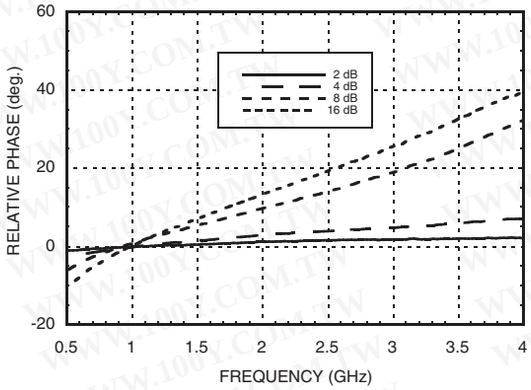
Absolute Bit Error vs. Frequency

(Only Major States are Shown)



Relative Phase vs. Frequency

(Only Major States are Shown)



Note: All Data Typical Over Voltage (+3V to +5V) & Temperature (-40 to +85 deg. C.).

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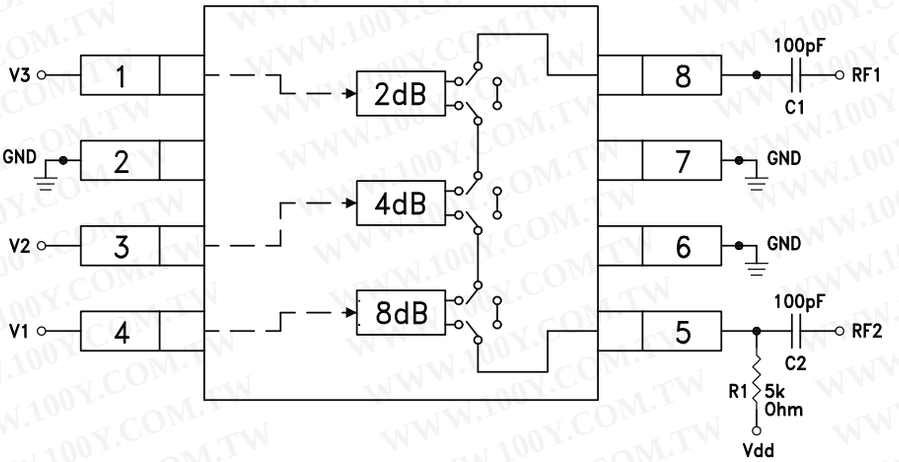
Truth Table

Control Voltage Input			Attenuation Setting RF1 - RF2
V1 8 dB	V2 4 dB	V3 2 dB	
High	High	High	Reference I.L.
High	High	Low	2 dB
High	Low	High	4 dB
Low	High	High	8 dB
Low	Low	Low	14 dB Max. Atten.
Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.			

Control & Bias Voltages

State	Bias Condition
Low	0 to +0.2V @ 20 uA Max.
High	Vdd ± 0.2V @ 50 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 throught either PIN 5 or PIN 8.

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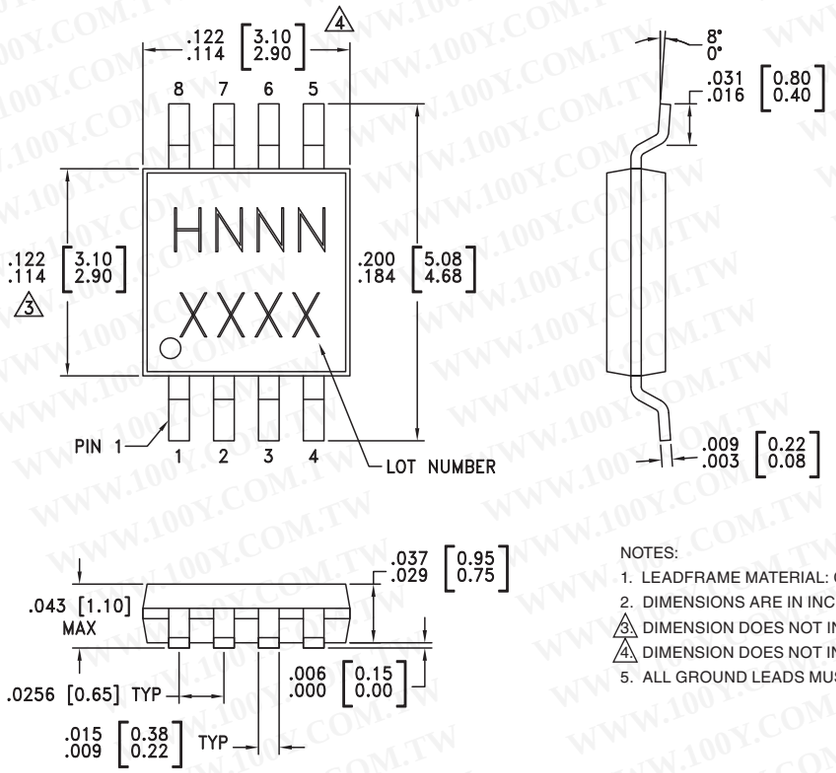
Absolute Maximum Ratings

Control Voltage (V1, V2, V3)	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 - 4 GHz)	+28 dBm

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



NOTES:

1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
4. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
5. ALL GROUND LEADS MUST BE SOLDERED TO PCB RF GROUND.

Package Information

Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking [3]
HMC288MS8	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL1 [1]	H288 XXXX
HMC288MS8E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 [2]	H288 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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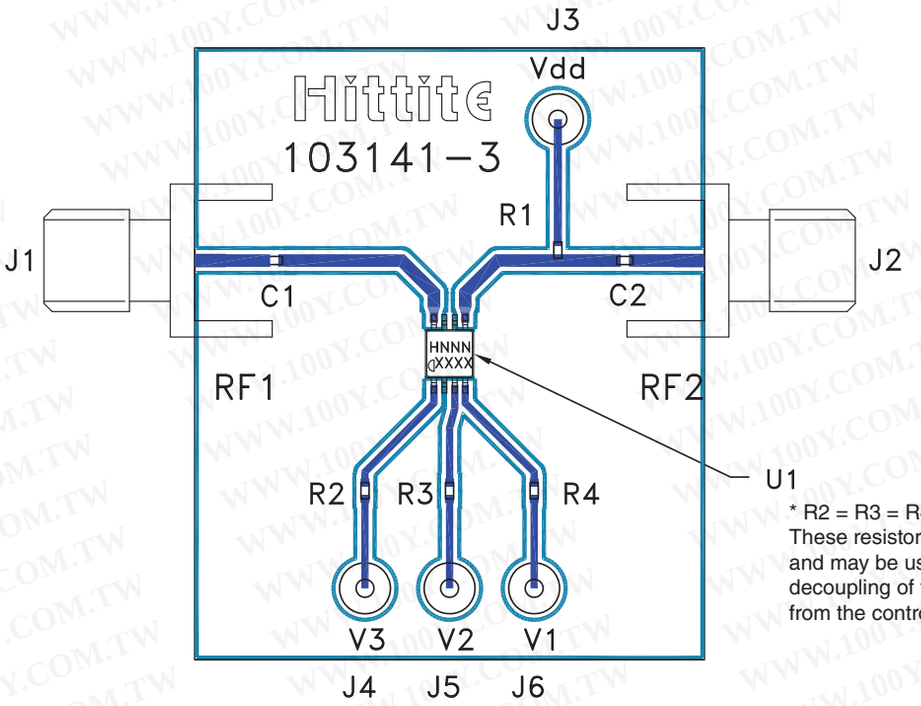
Evaluation Circuit Board



* R2 = R3 = R4 = 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 103143 [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	HMC288MS8 / HMC288MS8E Digital Attenuator
PCB [2]	103141 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 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.

Notes: