

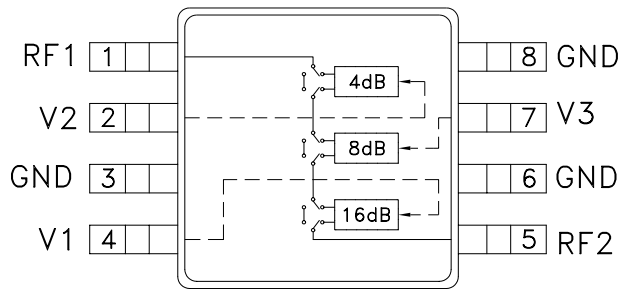
## 4 dB LSB GaAs MMIC 3-BIT DIGITAL ATTENUATOR, 0.75 - 2.0 GHz

### Typical Applications

The HMC230MS8 is ideal for:

- Cellular
- PCS, ISM, MMDS
- WLL Handset
- Base Station Infrastructure

### Functional Diagram



### Features

- 4 dB LSB Steps to 28 dB
- Single Positive Control Per Bit
- +/- 0.5 dB Typical Bit Error
- Pin - For - Pin Replacement to AA100-59 Digital Attenuator

### General Description

The HMC230MS8 is a broadband 3 - bit positive control GaAs IC digital attenuator in an 8 lead MSOP surface mount plastic package. Covering 0.75 to 2 GHz, the insertion loss is typically less than 2 dB. The attenuator bit values are 4 (LSB), 8, and 16 dB for a total attenuation of 28 dB. Accuracy is excellent at  $\pm 0.5$  dB typical with an IIP3 of up to +48 dBm. Three bit control voltage inputs, toggled between 0 and +3 to +5 volts, are used to select each attenuation state at less than 50 uA each. A single Vdd bias of +3 to +5 volts applied through an external 5K Ohm resistor is required.

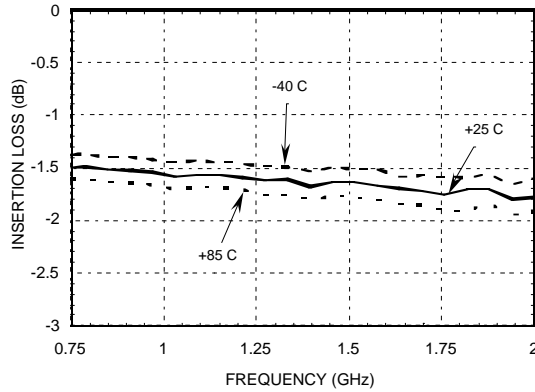
### Electrical Specifications,

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

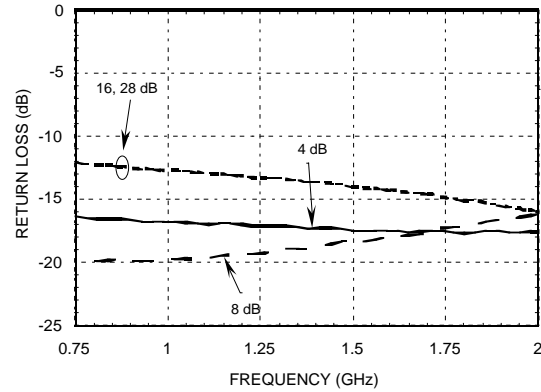
Parameter	Frequency	Min.	Typical	Max.	Units
Insertion Loss	0.75 - 1.7 GHz		1.6	1.8	dB
	1.7 - 2.0 GHz		1.8	2.1	dB
Attenuation Range	0.75 - 2.0 GHz		28		dB
Return Loss (RF1 & RF2, All Atten. States)	0.75 - 1.7 GHz	10	13		dB
	1.7 - 2.0 GHz	13	16		dB
Attenuation Accuracy: (Reference to Insertion Loss)					
4, 8, 12, 16, 20 dB States	0.75 - 1.4 GHz	$\pm 0.3 + 3\%$ of Atten. Setting Max			dB
24, 28 dB States	0.75 - 1.4 GHz	$\pm 0.4 + 6\%$ of Atten. Setting Max			dB
All Attenuation States	1.40 - 2.0 GHz	$\pm 0.3 + 3\%$ of Atten. Setting Max			dB
Input Power for 0.1 dB Compression	0.75 - 2.0 GHz	5V	20		dBm
		3V	19		dBm
Input Third Order Intercept (Two-Tone Input Power = 0 dBm Each)	0.75 - 2.0 GHz	5V	46		dBm
		3V	45		dBm
Switching Characteristics	0.75 - 2.0 GHz				
tRISE, tFALL (10/90% RF)			560		ns
tON, tOFF (50% CTL to 10/90% RF)			600		ns

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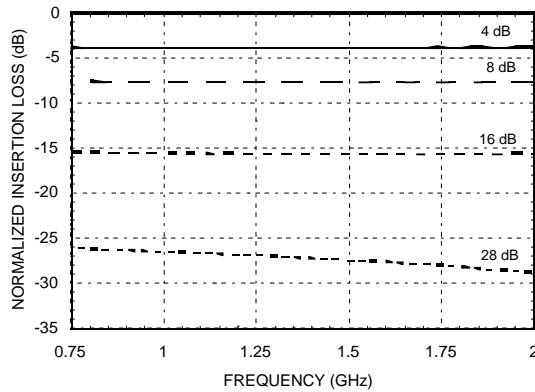
### Insertion Loss



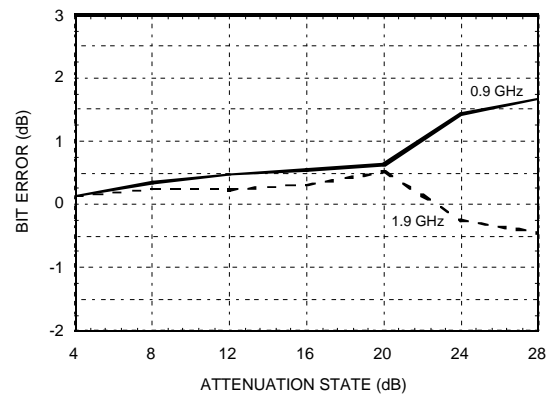
### Return Loss RF1, RF2 (Only Major States are Shown)



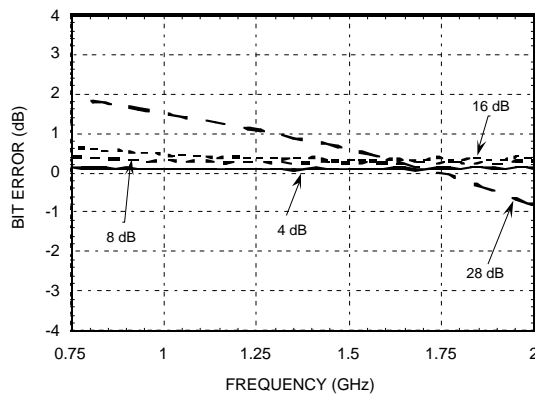
### Normalized Attenuation (Only Major States are Shown)



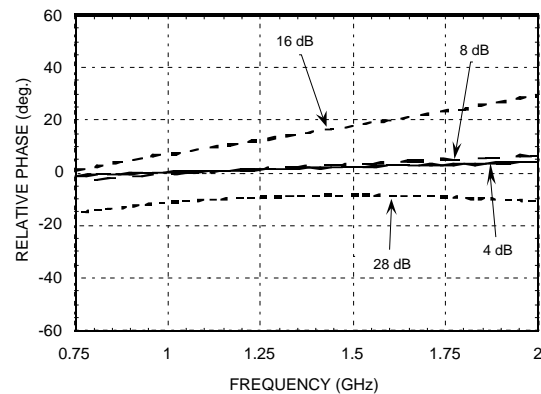
### Bit Error vs. Attenuation State



### 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) & Temperature (-40 to +85 deg C).

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

## 4 dB LSB GaAs IC 3-BIT DIGITAL ATTENUATOR, 0.75 - 2.0 GHz

### Truth Table

Control Voltage Input			Attenuation Setting RF1 - RF2
V1 16 dB	V2 4 dB	V3 8 dB	
High	High	High	Reference I.L.
High	Low	High	4 dB
High	High	Low	8 dB
Low	High	High	16 dB
Low	Low	Low	28 dB Max. Atten.

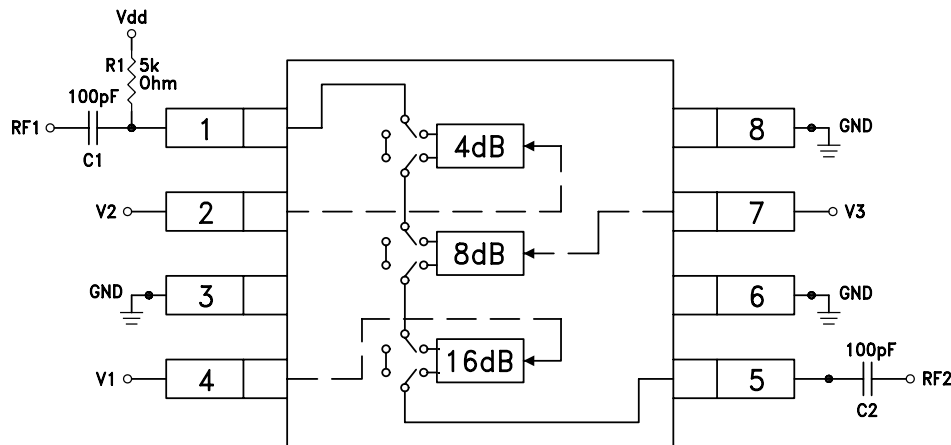
Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

### Control & Bias Voltages

State	Bias Condition
Low	0 to +0.2Vdc @ 20 uA Max
High	Vdd ±0.2V @ 50 uA Typ

Note: Vdd = +3V to +5V ± 0.2V

### Application Circuit

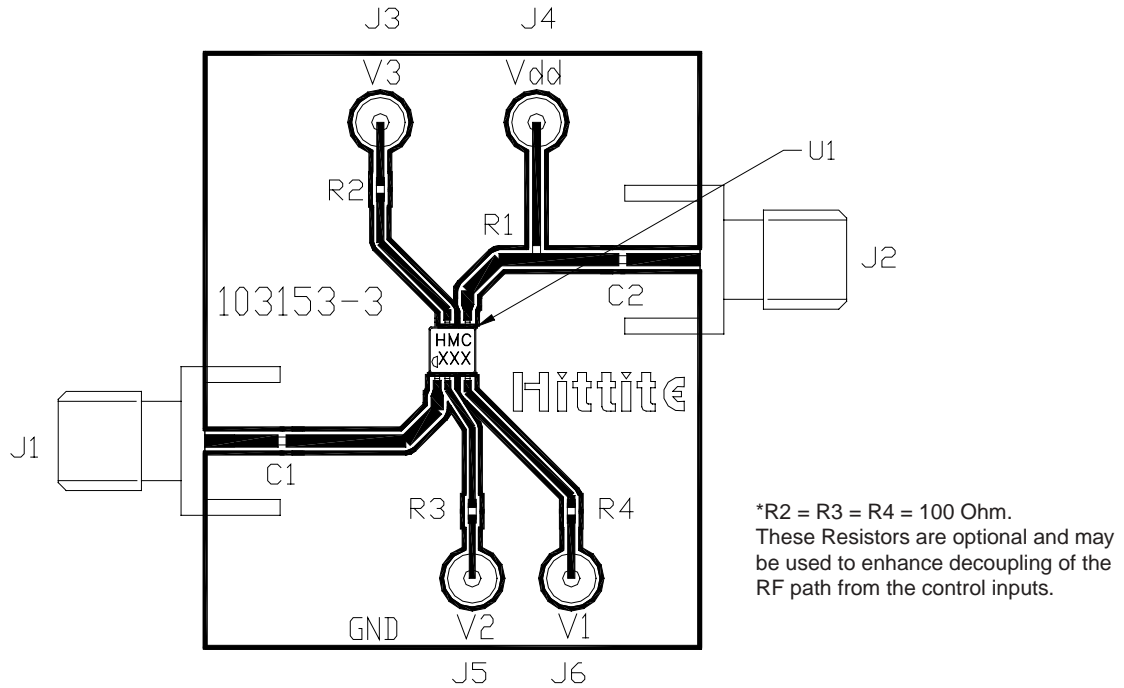


DC blocking capacitors C1 & C2 are required on RF1 & RF2. Choose C1 = C2 = 100 ~ 300 pF to allow lowest customer specific frequency to pass with minimal loss. R1 = 5K Ohm is required to supply voltage to the circuit through either PIN 1 or PIN 5.



## 4 dB LSB GaAs IC 3-BIT DIGITAL ATTENUATOR, 0.75 - 2.0 GHz

### 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.

### List of Material

Item	Description
J1 - J2	PC 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	HMC230MS8 Digital Attenuator
PCB*	103153 Evaluation PCB 1.25" x 1.5"
*Circuit Board Material: Rogers 4350	

## **4 dB LSB GaAs IC 3-BIT DIGITAL ATTENUATOR, 0.75 - 2.0 GHz**

**Notes:**