

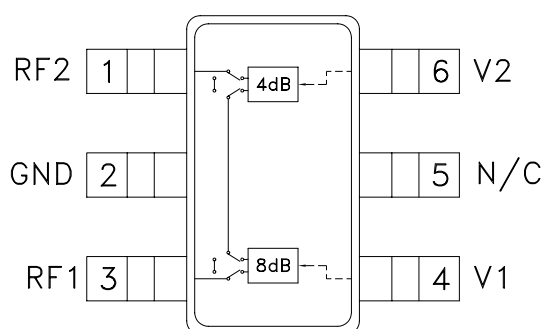
4 dB LSB GaAs MMIC 2-BIT DIGITAL ATTENUATOR, 0.7 - 4.0 GHz

Typical Applications

The HMC291 is ideal for:

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

Functional Diagram



Features

- 4 dB LSB Steps to 12 dB
- Single Positive Control Per BIT, 0/+3V
- +/-0.2 dB Typical Bit Error
- Miniature SOT 26 Package: 9 mm²

General Description

The HMC291 is a broadband 2 - bit positive control GaAs IC digital attenuator in a 6 lead SOT26 surface mount plastic package. Covering 0.7 to 4 GHz, the insertion loss is typically less than 0.7 to 1.3 dB. The attenuator bit values are 4 (LSB) and 8 dB for a total attenuation of 12 dB. Accuracy is excellent at ± 0.2 dB typical with an IIP3 of up to +54 dBm. Two 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.

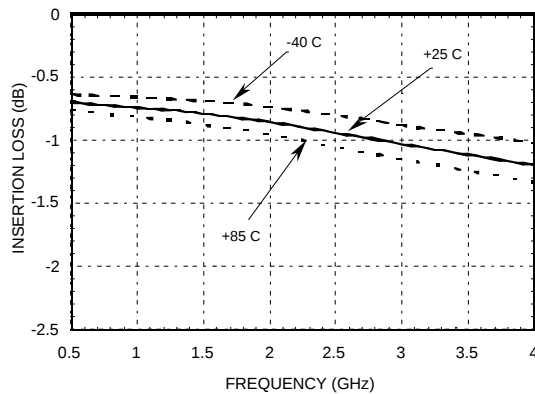
Electrical Specifications,

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

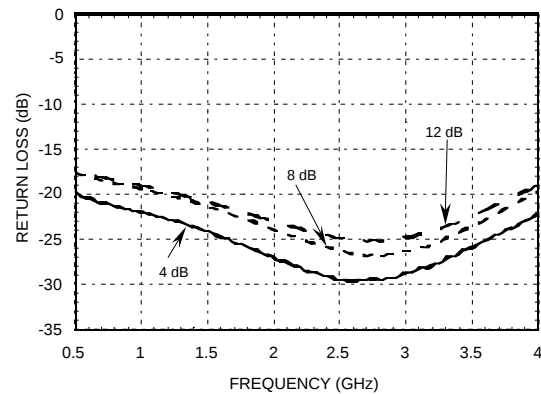
Parameter	Frequency	Min.	Typical	Max.	Units	
Insertion Loss	0.7 - 1.4 GHz		0.7	1.0	dB	
	1.4 - 2.3 GHz		0.9	1.3	dB	
	2.3 - 2.7 GHz		1.0	1.4	dB	
	2.7 - 4.0 GHz		1.1	1.6	dB	
Attenuation Range	0.7 - 4.0 GHz		12		dB	
Return Loss (RF1 & RF2, All Atten. States)	0.7 - 1.4 GHz	14	17		dB	
	1.4 - 4.0 GHz	16	22		dB	
Attenuation Accuracy: (Referenced to Insertion Loss)						
All Attenuation States	0.7 - 1.4 GHz	± 0.3 + 3% of Atten. Setting Max			dB	
All Attenuation States	1.4 - 2.3 GHz	± 0.2 + 2% of Atten. Setting Max			dB	
All Attenuation States	2.3 - 2.7 GHz	± 0.2 + 3% of Atten. Setting Max			dB	
All Attenuation States	2.7 - 4.0 GHz	± 0.4 + 5% of Atten. Setting Max			dB	
Input Power for 0.1 dB Compression	5V	0.7 - 4.0 GHz		26		dBm
	3V			22		dBm
Input Third Order Intercept Point (Two-tone Input Power = 0 dBm Each Tone)	5V	0.7 - 4.0 GHz		54		dBm
	3V			50		dBm
Switching Characteristics	0.7 - 4.0 GHz					
tRISE, tFALL (10/90% RF)				560		ns
tON, tOFF (50% CTL to 10/90% RF)				600		ns

**4 dB LSB GaAs MMIC 2-BIT DIGITAL
ATTENUATOR, 0.7 - 4.0 GHz**

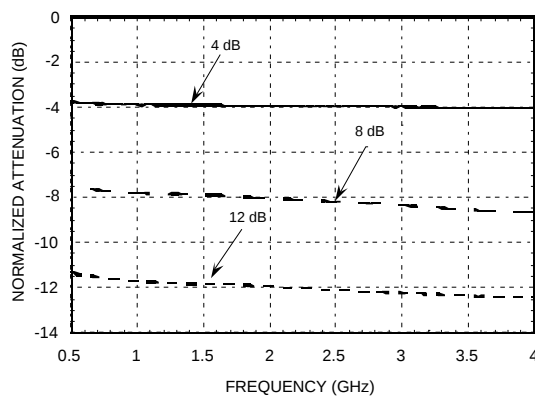
Insertion Loss



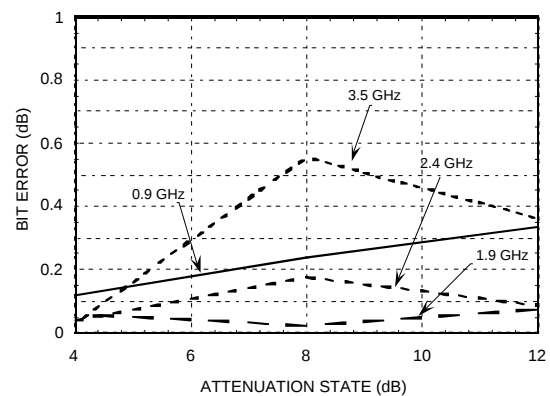
Return Loss RF1, RF2



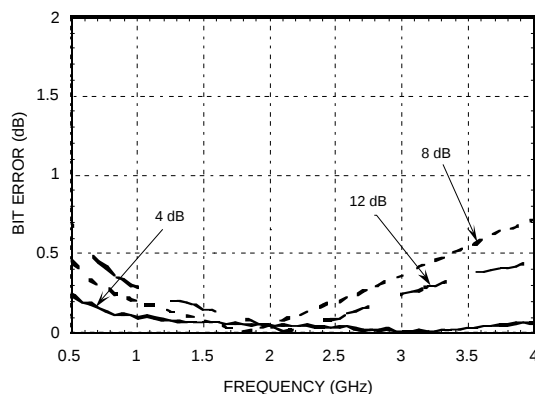
Normalized Attenuation



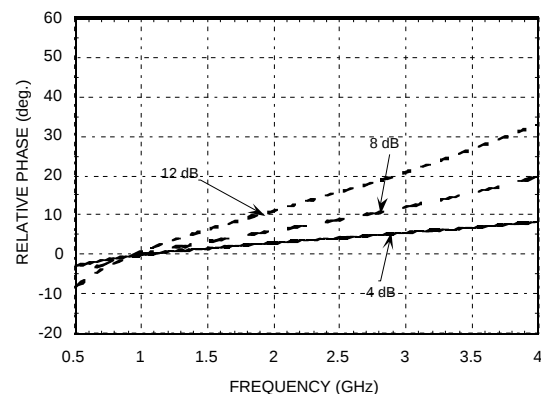
**Absolute Bit Error
vs. Attenuation State**



Absolute Bit Error vs. Frequency



Relative Phase vs. Frequency



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

4 dB LSB GaAs MMIC 2-BIT DIGITAL ATTENUATOR, 0.7 - 4.0 GHz

Truth Table

Control Voltage Input		Attenuation Setting RF1 - RF2
V1 8 dB	V2 4 dB	
High	High	Reference I.L.
High	Low	4 dB
Low	High	8 dB
Low	Low	12 dB Max. Atten.

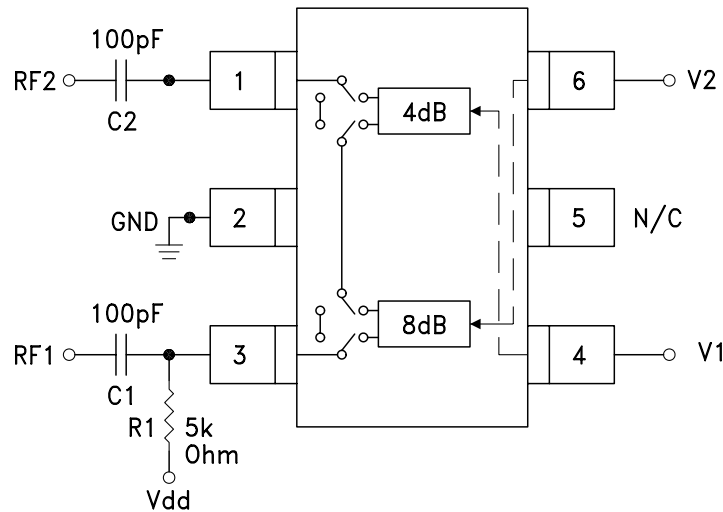
Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

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



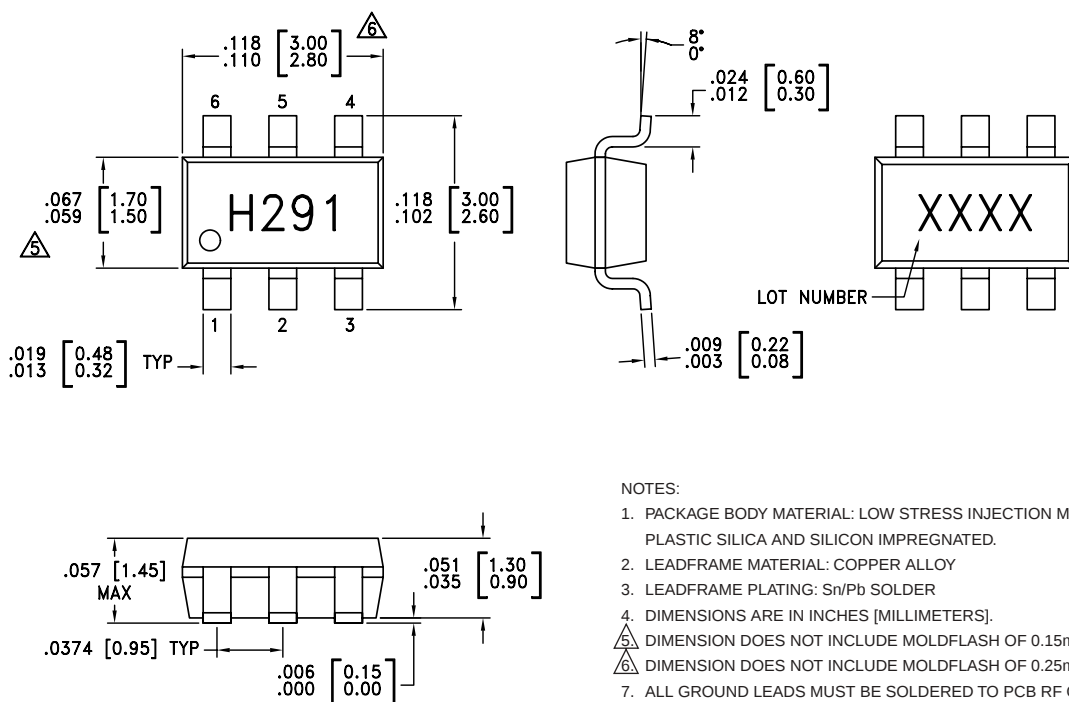
DC blocking capacitors C1 & C2 are required on RF1 & RF2. Choose C1 = C2 = 100 ~ 300 pF to allow lowest customer specific frequency to pass with minimal loss. R1 = 5K Ohm is required to supply voltage to the circuit through either PIN 3 or PIN 1.

4 dB LSB GaAs MMIC 2-BIT DIGITAL ATTENUATOR, 0.7 - 4.0 GHz

Absolute Maximum Ratings

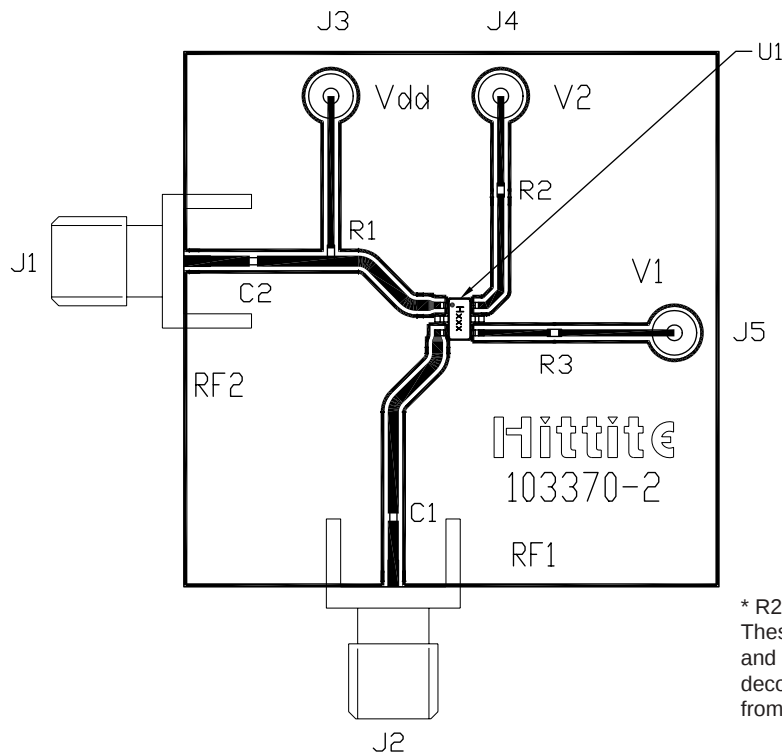
Control Voltage (V1, V2)	Vdd + 0.5 Vdc
Bias Voltage (Vdd)	+8.0 Vdc
Storage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C
RF Input Power (0.7 - 4 GHz)	+28 dBm

Outline Drawing



4 dB LSB GaAs MMIC 2-BIT DIGITAL ATTENUATOR, 0.7 - 4.0 GHz

Evaluation Circuit Board



* R2 = R3 = 100 Ohm.
These resistors are optional and may be used to enhance decoupling of the RF path from the control inputs.

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	100 Ohm Resistor, 0402 Chip
C1, C2	0402 Chip Capacitor, Select for Lowest Frequency of Operation
U1	HMC291 Digital Attenuator
PCB*	103370 Evaluation PCB 1.5" x 1.5"
*Circuit Board Material Rogers 4350	

4 dB LSB GaAs MMIC 2-BIT DIGITAL ATTENUATOR, 0.7 - 4.0 GHz

Notes: