v02.0402

HMC291 / 291E

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

Designer's Kit Available

Typical Applications

The HMC291 & HMC291E are ideal for:

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

Features

RoHS Compliant Product

4 dB LSB Steps to 12 dB

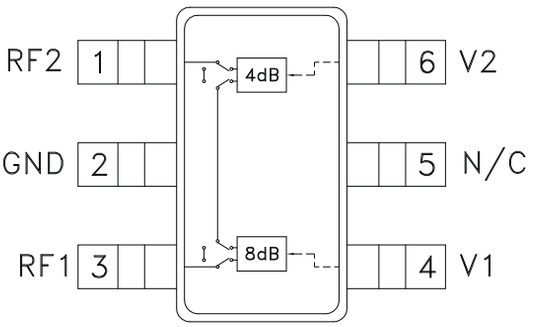
Single Positive Control Per BIT, 0/+3V

±0.2 dB Typical Bit Error

Miniature SOT 26 Package: 9 mm^2

Included in the HMC-DK004 Designer's Kit

Functional Diagram



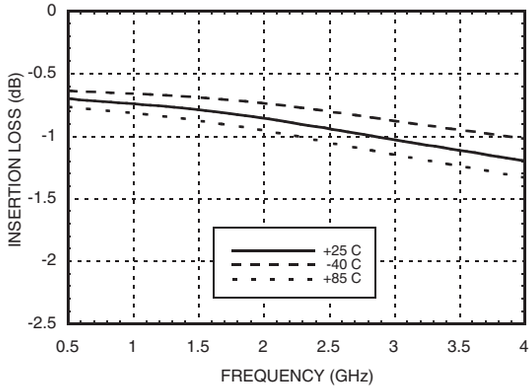
General Description

The HMC291 & HMC291E are general purpose broadband 2-bit positive control GaAs IC digital attenuators in 6 lead SOT26 surface mount plastic packages. 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.

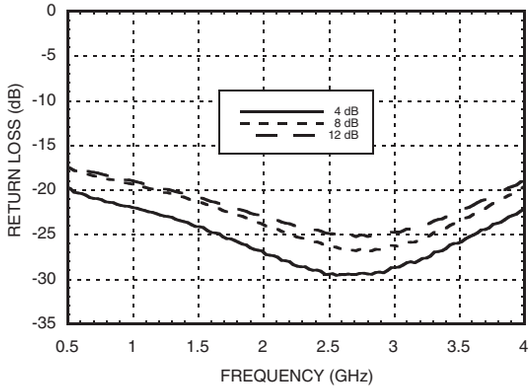
Electrical Specifications, T_A = +25° C, Vdd = +3V to +5V & Vctl = 0/Vdd (Unless Otherwise Stated)

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

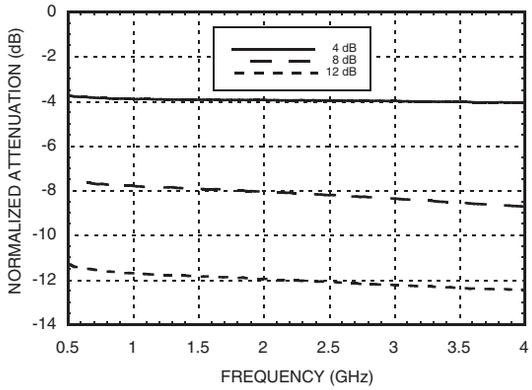
Insertion Loss



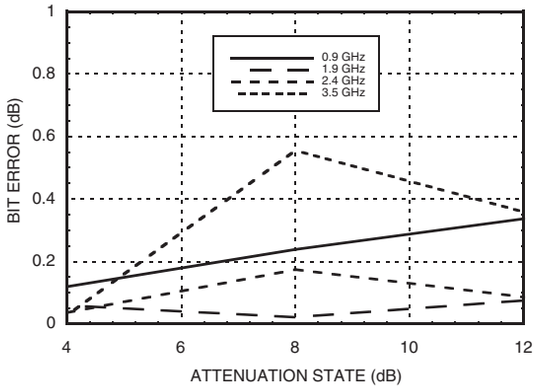
Return Loss RF1, RF2



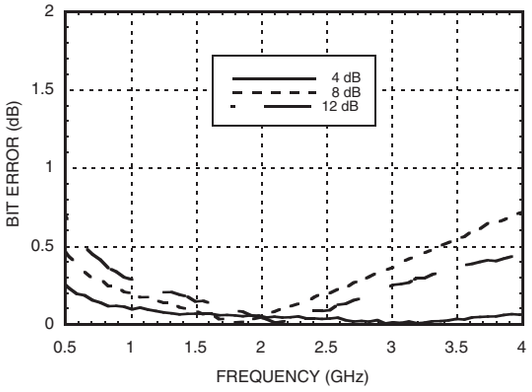
Normalized Attenuation



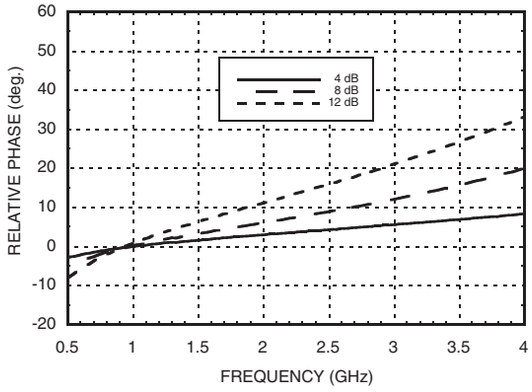
Absolute Bit Error vs. Attenuation State



Absolute Bit Error vs. Frequency



Relative Phase vs. Frequency



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

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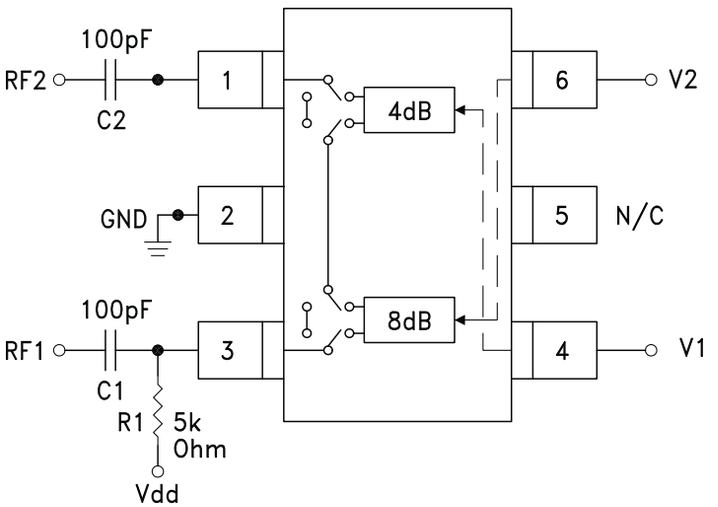
Truth Table

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



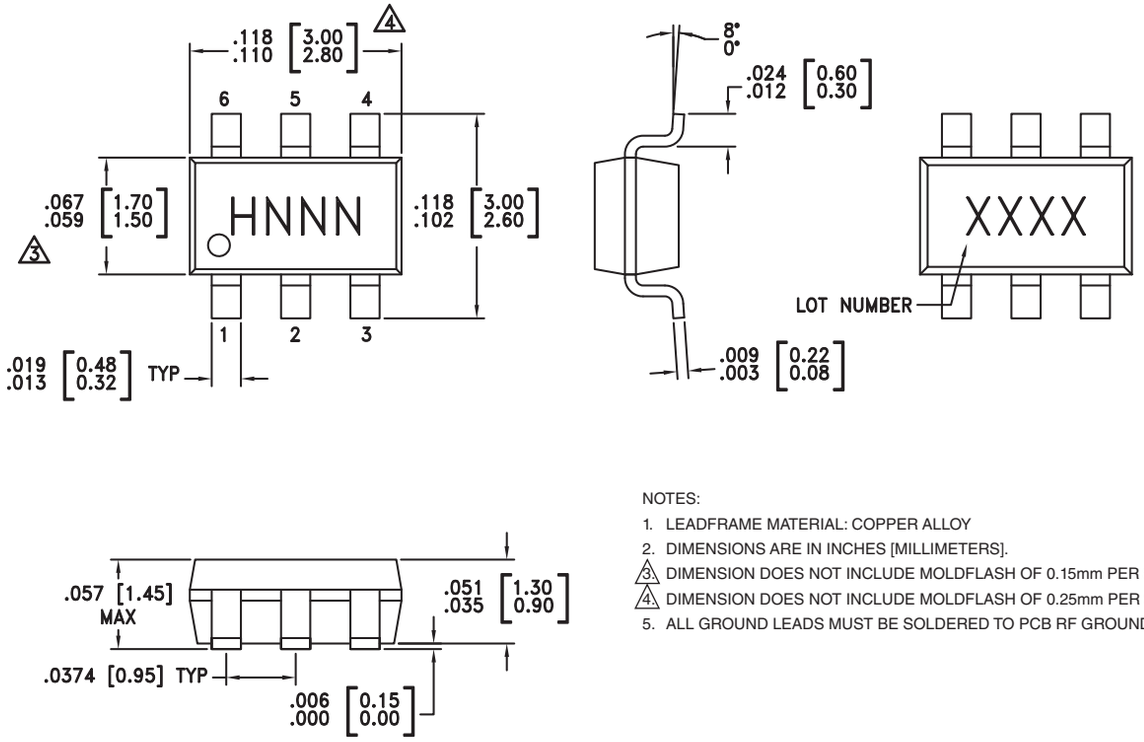
DC blocking capacitors C1 & C2 are required on RF1 & RF2. Choose C1 = C2 = 100 ~ 300 pF to allow lowest customer specific frequency to pass with minimal loss. R1 = 5K Ohm is required to supply voltage to the circuit throught either PIN 3 or PIN 1.

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
ESD Sensitivity (HBM)	Class 1A

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



NOTES:

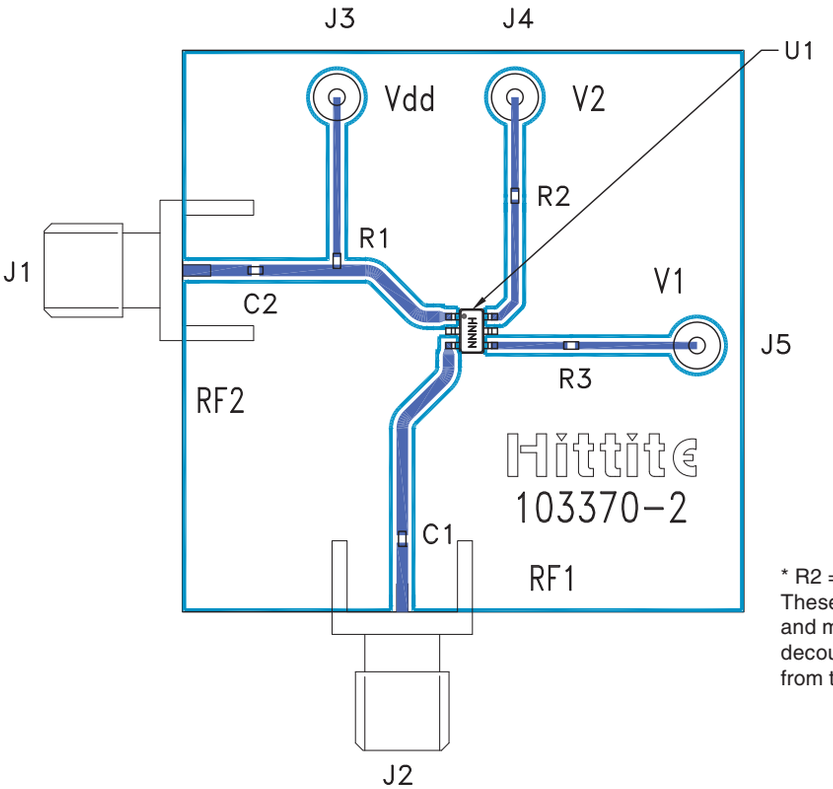
1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS].
3. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
4. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
5. ALL GROUND LEADS MUST BE SOLDERED TO PCB RF GROUND.

Package Information

Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking
HMC291	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL1 [1]	H291 XXXX
HMC291E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 [2]	291E XXXX

[1] Max peak reflow temperature of 235 °C
[2] Max peak reflow temperature of 260 °C

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.

List of Materials for Evaluation PCB 103372 [1]

Item	Description
J1 - J2	PCB 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 / HMC291E Digital Attenuator
PCB [2]	103370 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: