

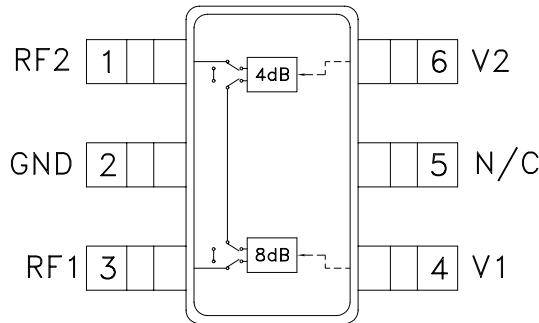

4 dB LSB GaAs MMIC 2-BIT DIGITAL ATTENUATOR, 0.7 - 4.0 GHz
Typical Applications

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
- Typical Bit Error : ± 0.2 dB
- Miniature SOT 26 Package: 9 mm²
- 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 μ A each. A single Vdd bias of +3 to +5 volts applied through an external 5K Ohm resistor is required.

Electrical Specifications,

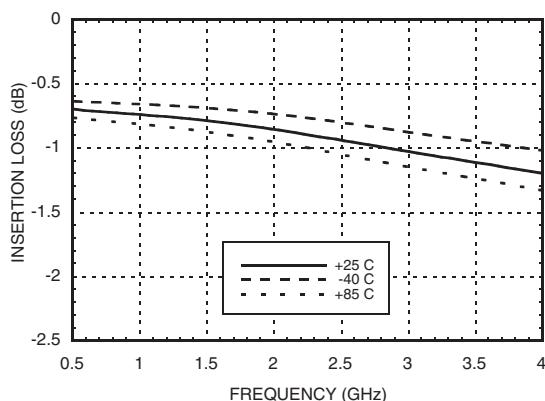
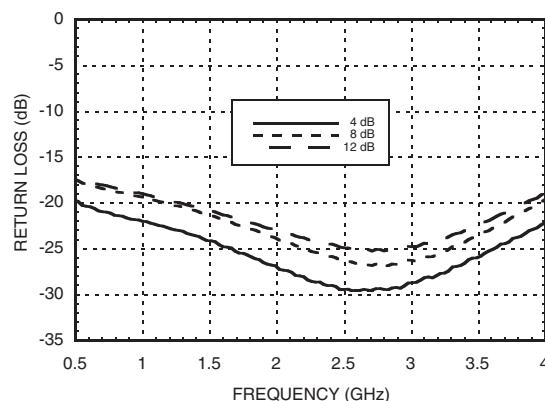
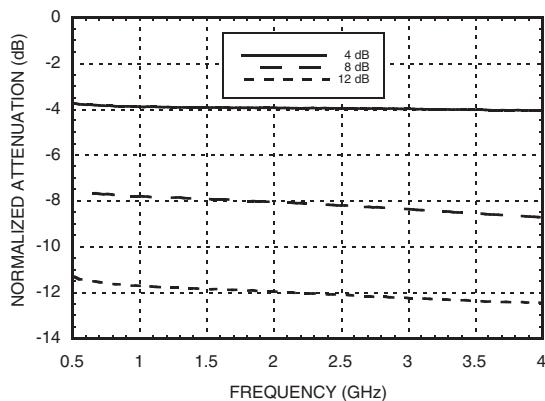
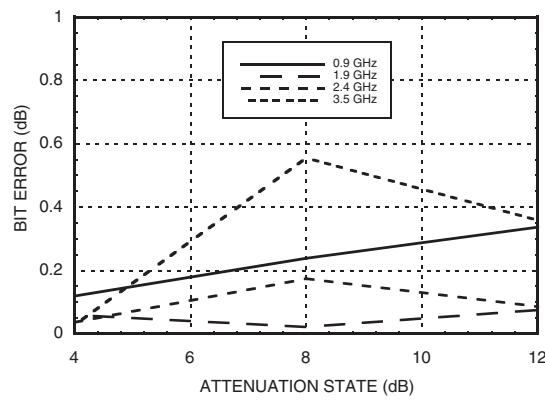
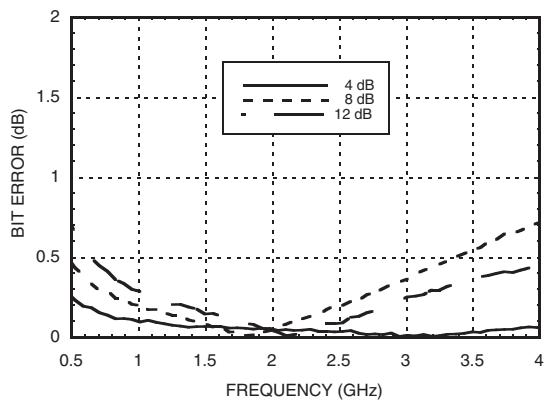
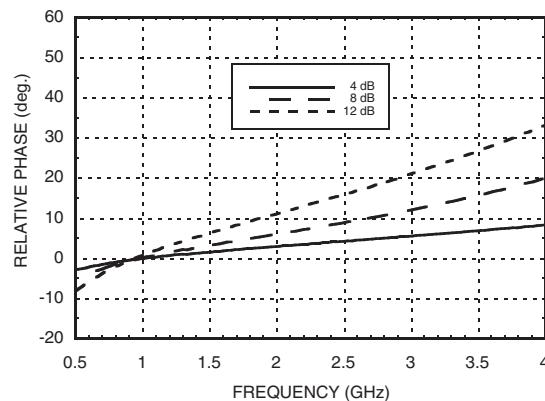
$T_A = +25^\circ C$, $Vdd = +3V$ to $+5V$ & $Vctl = 0/Vdd$ (Unless Otherwise Stated)

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
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)	0.7 - 1.4 GHz 1.4 - 2.3 GHz 2.3 - 2.7 GHz 2.7 - 4.0 GHz		$\pm 0.3 + 3\%$ of Atten. Setting Max $\pm 0.2 + 2\%$ of Atten. Setting Max $\pm 0.2 + 3\%$ of Atten. Setting Max $\pm 0.4 + 5\%$ 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	0.7 - 4.0 GHz				
t_{RISE}, t_{FALL} (10/90% RF) t_{ON}, t_{OFF} (50% CTL to 10/90% RF)			560 600		ns ns

For price, delivery and to place orders: Hittite Microwave Corporation, 2 Elizabeth Drive, Chelmsford, MA 01824

Phone: 978-250-3343 Fax: 978-250-3373 Order On-line at www.hittite.com

Application Support: Phone: 978-250-3343 or apps@hittite.com

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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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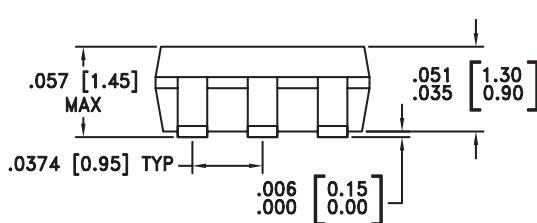
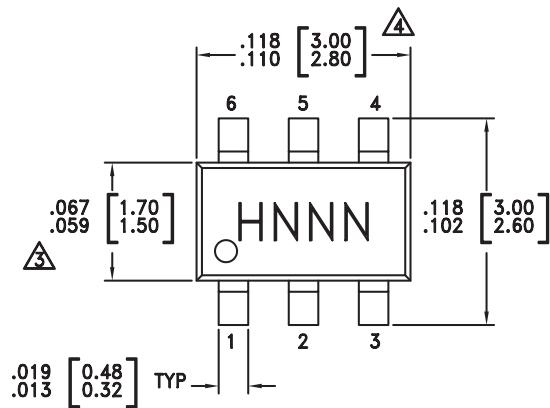
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Truth Table

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.

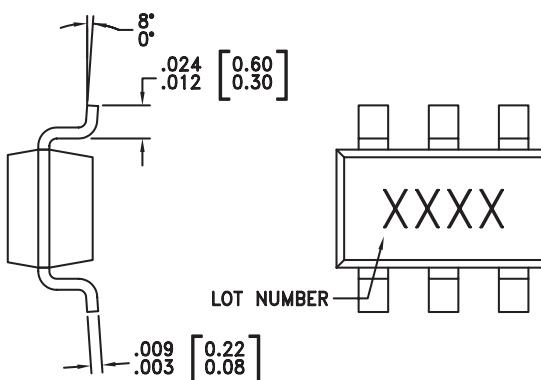

**ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS**
Outline Drawing

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

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



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

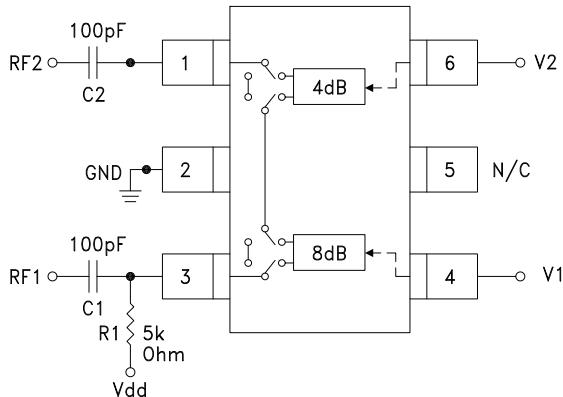
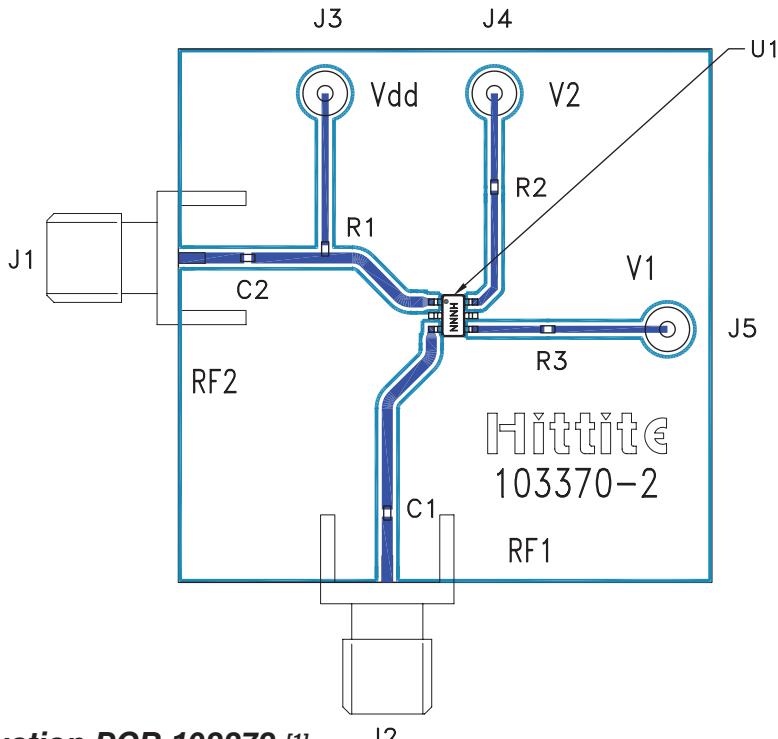
[2] Max peak reflow temperature of 260 °C

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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.


Evaluation Circuit Board

List of Materials for Evaluation PCB 103372 [1]

Item	Description
J1 - J2	PCB Mount SMA Connector
J3 - J6	DC Pin
R1	5 kOhm 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"

The circuit board used in the 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.

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350