



0.5 DB LSB GAAS MMIC 5-BIT DIGITAL ATTENUATOR, 0.7 - 3.8 GHz

Typical Applications

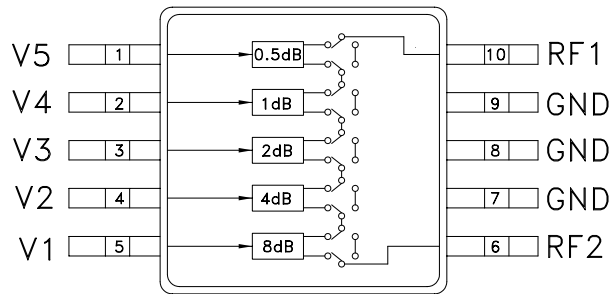
The HMC306AMS10 / 306AMS10E is ideal for:

- Cellular; UMTS/3G Infrastructure
- ISM, MMDS, WLAN, WiMAX
- Microwave Radio & VSAT
- Test Equipment and Sensors

Features

- RoHS-Compliant Product
- 0.5 dB LSB Steps to 15.5 dB
- Single Positive Control Per Bit
- ± 0.2 dB Typical Bit Error
- Miniature 15 mm² Package: MSOP10

Functional Diagram



General Description

The HMC306AMS10 & HMC306AMS10E are general purpose broadband 5-bit positive control GaAs IC digital attenuators in 10 lead MSOP surface mount plastic packages. Covering 0.7 to 3.8 GHz, the insertion loss is typically less than 1.5 to 2.3 dB. These attenuators' bit values are 0.5 (LSB), 1, 2, 4 and 8 dB for a total attenuation of 15.5 dB. Attenuation accuracy is excellent at ± 0.2 dB typical with an IIP3 of up to +52 dBm. Five bit control voltage inputs, toggled between 0 and +3 to +5V, are used to select each attenuation state. A single Vdd bias of +3 to +5V 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 (GHz) | Min. | Typical | Max. | Units |
|---|-----------------|--------------------------------------|---------|------|-------|
| Insertion Loss | 0.7 - 1.4 | | 1.3 | 1.6 | dB |
| | 1.4 - 2.3 | | 1.5 | 2.0 | dB |
| | 2.3 - 2.7 | | 1.8 | 2.5 | dB |
| | 2.7 - 3.8 | | 2.3 | 2.7 | dB |
| Attenuation Range | | | 15.5 | | dB |
| Return Loss (RF1 & RF2, All Atten. States) | 0.7 - 1.4 | 15 | 21 | | dB |
| | 1.4 - 2.3 | 14 | 18 | | dB |
| | 2.3 - 2.7 | 13 | 16 | | dB |
| | 2.7 - 3.8 | 10 | 13 | | dB |
| Attenuation Accuracy: (Referenced to Insertion Loss) All Attenuation States 0.5 - 7.5 dB States 8.0 - 15.5 dB States All Attenuation States | 0.7 - 1.4 | ± (0.30 + 5% of Atten. Setting) Max. | | | dB |
| | 1.4 - 2.3 | ± (0.25 + 3% of Atten. Setting) Max. | | | dB |
| | 1.4 - 2.3 | ± (0.15 + 3% of Atten. Setting) Max. | | | dB |
| | 2.3 - 3.8 | ± (0.30 + 3% of Atten. Setting) Max. | | | dB |
| Input Power for 0.1 dB Compression | 0.7 - 3.8 | Vdd = 5V | 28 | | dBm |
| | | Vdd = 3V | 27 | | dBm |
| Input Third Order Intercept Point (Two-tone Input Power = 10 dBm Each Tone) | 0.7 - 3.8 | Vdd = 5V | 52 | | dBm |
| | | Vdd = 3V | 48 | | dBm |
| Switching Characteristics | 0.7 - 3.8 | tRISE, tFALL (10/90% RF) | 560 | | ns |
| | | tON, tOFF (50% CTL to 10/90% RF) | 600 | | ns |
| | | | | | |

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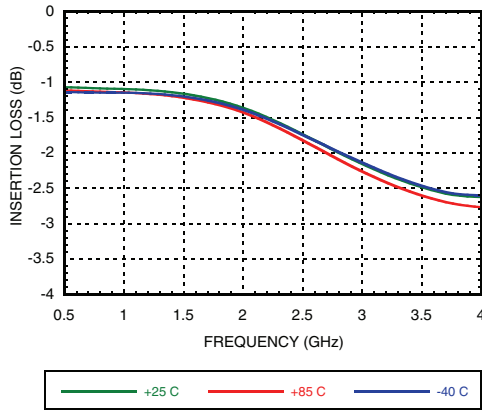
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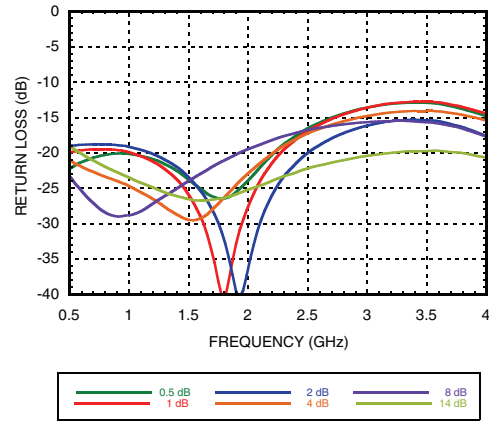
HMC306AMS10 / 306AMS10E

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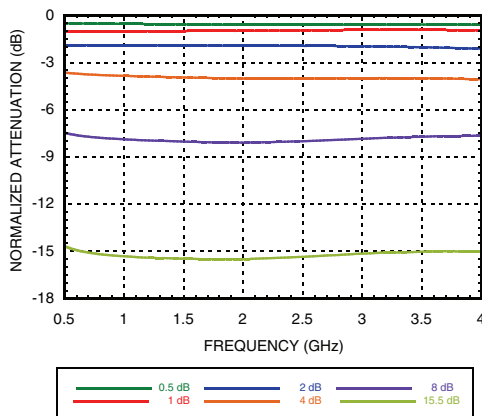
Insertion Loss



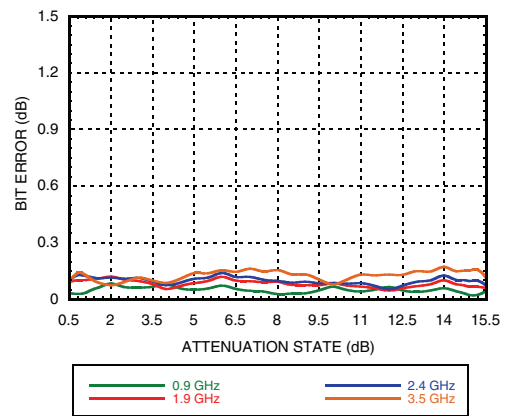
Return Loss RF1, RF2 (Only Major States are Shown)



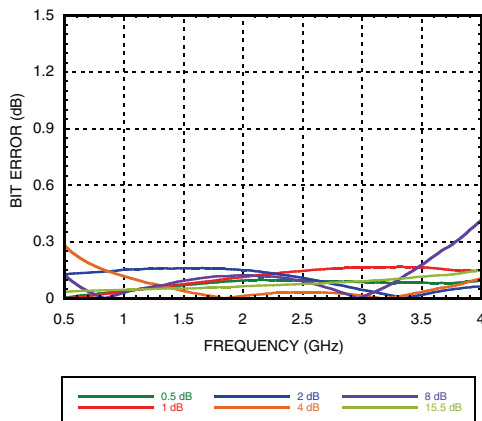
Normalized Attenuation (Only Major States are Shown)



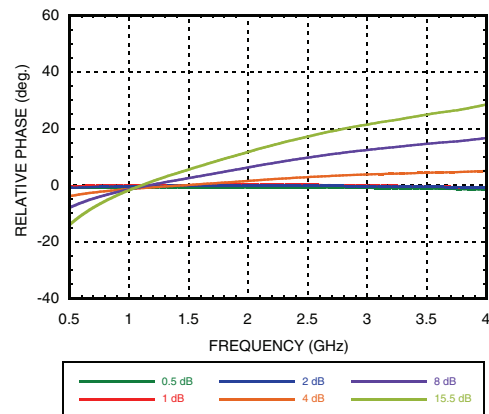
Absolute Bit Error vs. Attenuation State



Absolute Bit Error vs. Frequency (Only Major States are Shown)



Relative Phase vs. Frequency (Only Major States are Shown)



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Truth Table

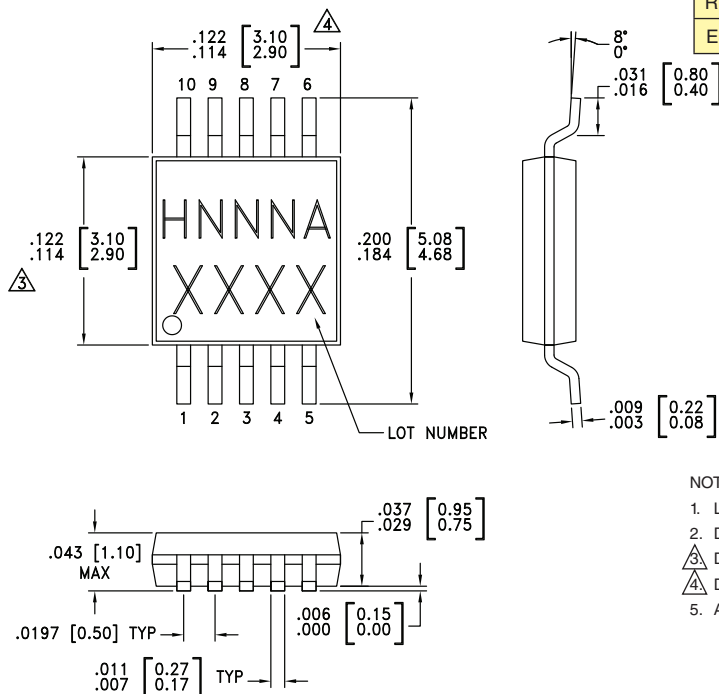
| Control Voltage Input | | | | | Attenuation State RF1 - RF2 |
|-----------------------|------------|------------|------------|--------------|--------------------------------|
| V1 8 dB | V2 4 dB | V3 2 dB | V4 1 dB | V5 0.5 dB | |
| High | High | High | High | High | Reference I.L. |
| High | High | High | High | Low | 0.5 dB |
| High | High | High | Low | High | 1 dB |
| High | High | Low | High | High | 2 dB |
| High | Low | High | High | High | 4 dB |
| Low | High | High | High | High | 8 dB |
| Low | Low | Low | Low | Low | 15.5 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 μA Max. |
| High | Vdd ± 0.2V @ 20 μA Max. |

Note: Vdd = +3V to 5V ± 0.2V

Absolute Maximum Ratings

| | |
|---|----------------|
| Control Voltage (V1 - V5) | Vdd + 0.2 Vdc |
| Bias Voltage (Vdd) | +8 Vdc |
| Channel Temperature | 150 °C |
| Continuous P _{diss} (T = 85 °C) (derate 7.8 mW/ °C above 85 °C) | 0.506 W |
| Thermal Resistance (Channel to package bottom) | 128.5 °C/w |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -40 to +85 °C |
| RF Input Power (0.7 - 3.8 GHz) | +27 dBm |
| ESD Sensitivity (HBM) | Class 1A |

NOTES:

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

Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[3] |
|--------------|--|---------------|---------------------|--------------------------------|
| HMC306AMS10 | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 ^[1] | H306A XXXX |
| HMC306AMS10E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 ^[2] | H306A XXXX |

[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

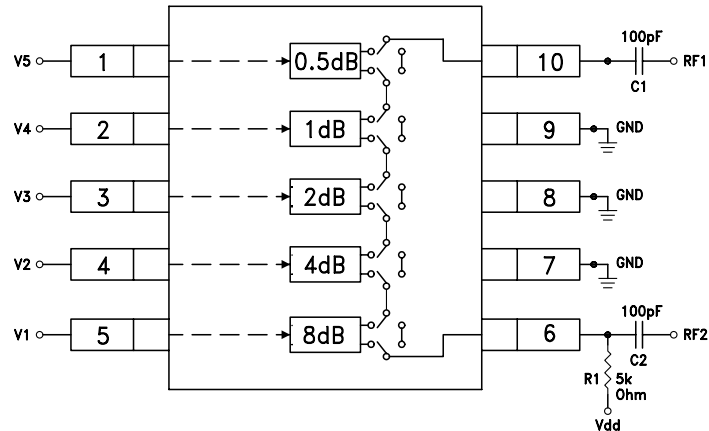
[3] 4-Digit lot number XXXX



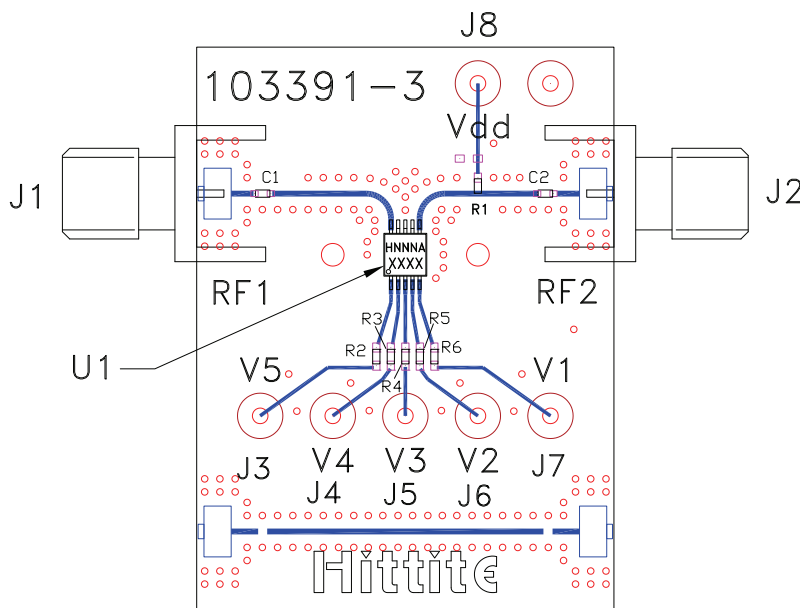
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Application Circuit

Note:
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 6 or Pin 10.



Evaluation Circuit Board



* R2 - R6= 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 EVAL01 - HMC306AMS10 [1]

| Item | Description |
|---------|--|
| J1 - J2 | PCB Mount SMA Connector |
| J3 - J8 | DC Pin |
| R1 | 5 kOhm Resistor, 0402 Pkg. |
| R2 - R6 | 100 Ohm Resistor, 0402 Pkg. |
| C1 - C2 | 0402 Chip Capacitor, Select Value for Lowest Frequency |
| U1 | HMC306AMS10 / 306AMS10E Digital Attenuators |
| PCB [2] | 103391 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 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 shown is available from Hittite upon request.