



Typical Applications

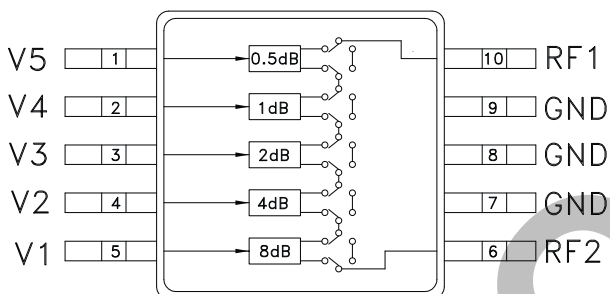
The HMC306MS10 / HMC306MS10E is ideal for:

- 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
- Included in the HMC-DK004 Designer's Kit

Functional Diagram



General Description

The HMC306MS10 & HMC306MS10E 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)

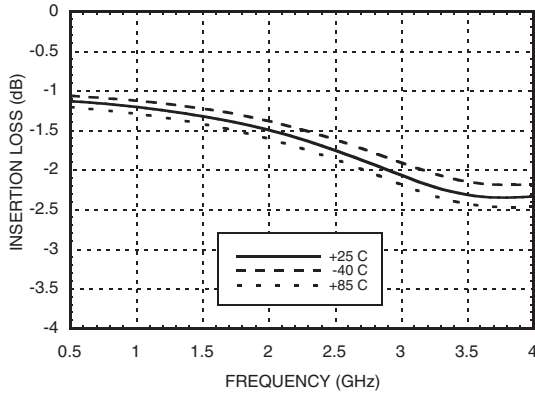
| Parameter | Frequency (GHz) | Min. | Typical | Max. | Units | |
|--------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------|---------|------|----------------------------------|-----|
| Insertion 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 | 0.7 - 1.4 | ± (0.30 + 5% of Atten. Setting) Max. | | | dB | |
| | 1.4 - 2.3 | ± (0.25 + 3% of Atten. Setting) Max. | | | dB | |
| | 0.5 - 7.5 dB States | ± (0.15 + 3% of Atten. Setting) Max. | | | dB | |
| | 8.0 - 15.5 dB States All Attenuation States | ± (0.30 + 3% of Atten. Setting) Max. | | | dB | |
| Input Power for 0.1 dB Compression | Vdd = 5V Vdd = 3V | 0.7 - 3.8 | 25 | | dBm | |
| | | | 23 | | dBm | |
| Input Third Order Intercept Point (Two-tone Input Power = 0 dBm Each Tone) | Vdd = 5V Vdd = 3V | 0.7 - 3.8 | 52 | | dBm | |
| | | | 48 | | dBm | |
| Switching Characteristics | 0.7 - 3.8 | | 560 | | ns | |
| | | | | | tRISE, tFALL (10/90% RF) | |
| | | | | | tON, tOFF (50% CTL to 10/90% RF) | 600 |

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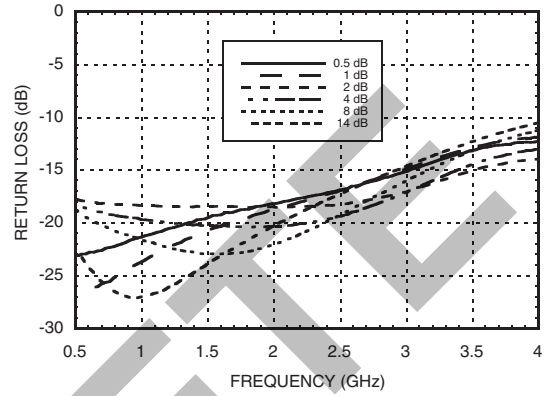
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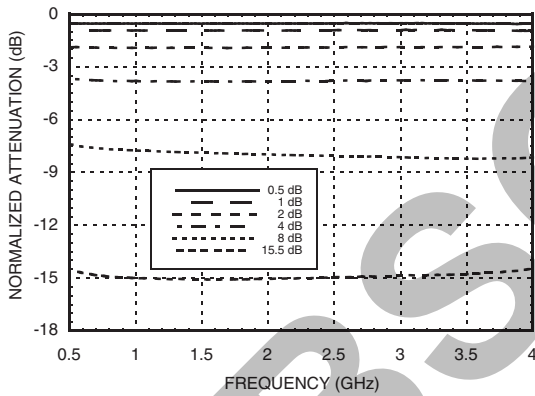
Insertion Loss



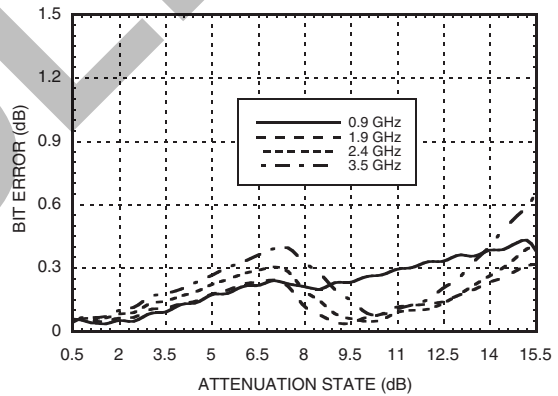
Return Loss RF1, RF2
(Only Major States are Shown)



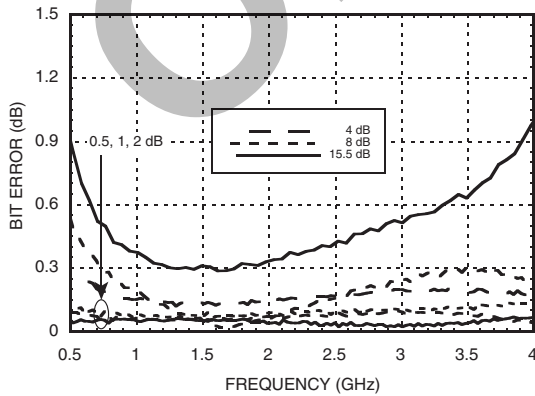
Normalized Attenuation
(Only Major States are Shown)



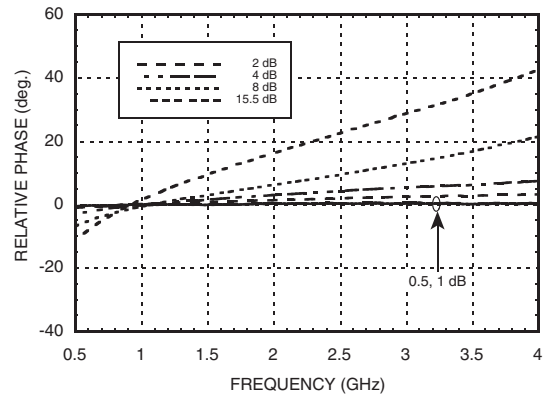
Absolute Bit Error vs. Attenuation State



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. |

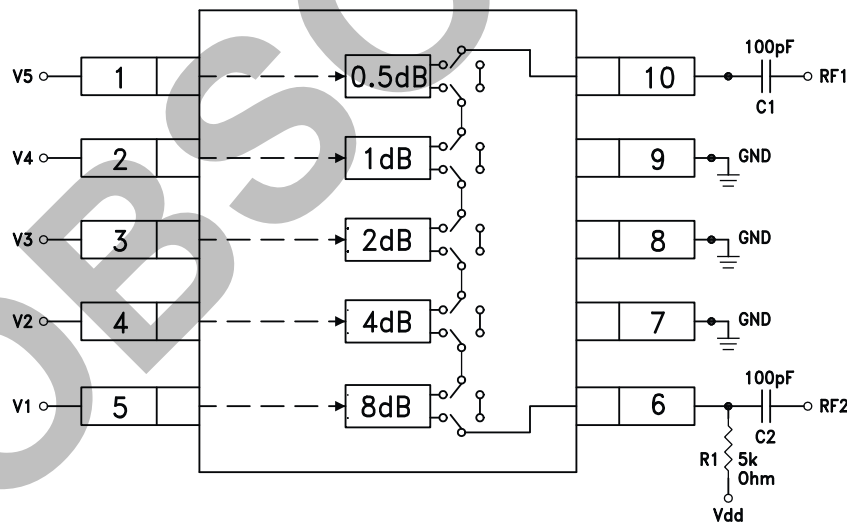
Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

Control & Bias Voltages

| State | Bias Condition |
|-------|----------------------------------|
| Low | 0 to +0.2V @ 20 μ A Max. |
| High | Vdd \pm 0.2V @ 20 μ A Max. |

Note: Vdd = +3V to 5V \pm 0.2V

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.

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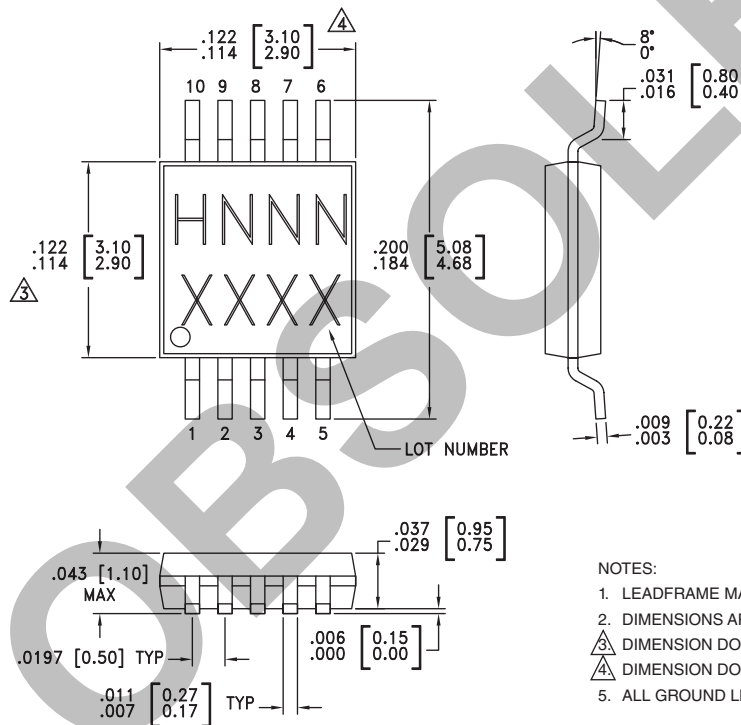
Absolute Maximum Ratings

| | |
|--------------------------------|----------------|
| Control Voltage (V1 - V5) | 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 - 3.8 GHz) | +28 dBm |
| ESD Sensitivity (HBM) | Class 1A |



ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



NOTES:

- LEADFRAME MATERIAL: COPPER ALLOY
- DIMENSIONS ARE IN INCHES [MILLIMETERS].
- \triangle DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
- \triangle 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] |
|-------------|----------------------------------------------------|---------------|---------------------|--------------------------------|
| HMC306MS10 | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 ^[1] | H306 XXXX |
| HMC306MS10E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 ^[2] | H306 XXXX |

[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

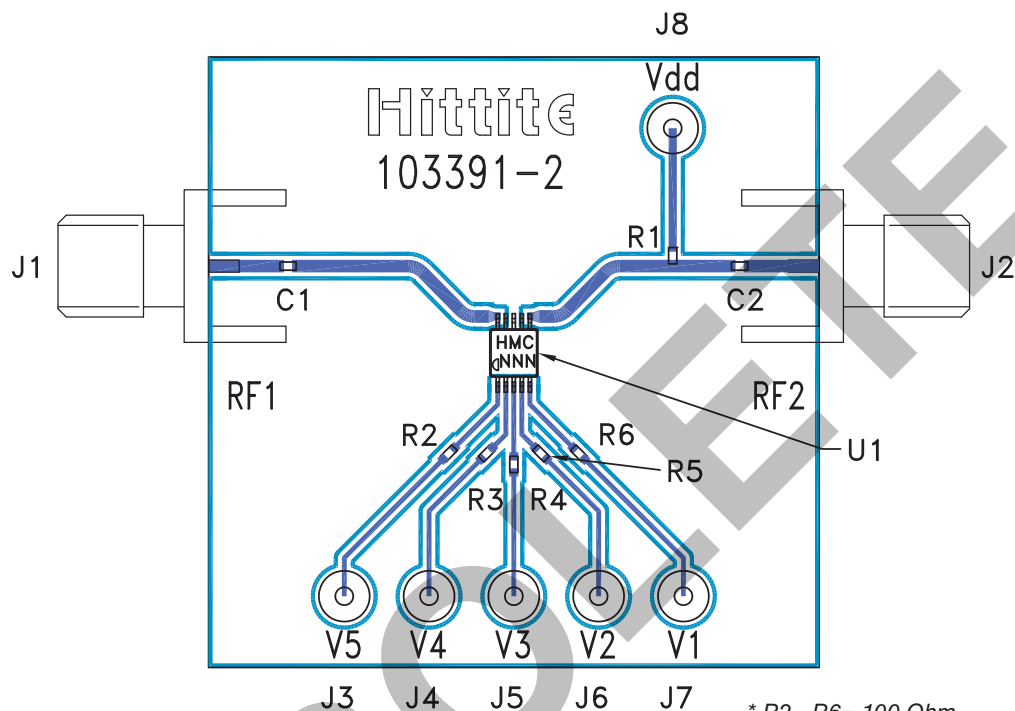
[3] 4-Digit lot number XXXX

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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 103393 [1]

| Item | Description |
|---------|---------------------------------------------------------|
| J1 - J2 | PCB Mount SMA Connector |
| J3 - J8 | DC Pin |
| R1 | 5k Ohm Resistor, 0402 Pkg. |
| R2 - R6 | 100 Ohm Resistor, 0402 Pkg. |
| C1 - C2 | 0402 Chip Capacitor, Select Value for Lowerst Frequency |
| U1 | HMC306MS10 / HMC306MS10E 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 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 shown is available from Hittite upon request.



Notes:

HMC306MS10 / 306MS10E

v06.0206

0.5 dB LSB GaAs MMIC 5-BIT DIGITAL
ATTENUATOR, 0.7 - 3.8 GHz

OBSOLETE

5

ATTENUATORS - SMT

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