



Typical Applications

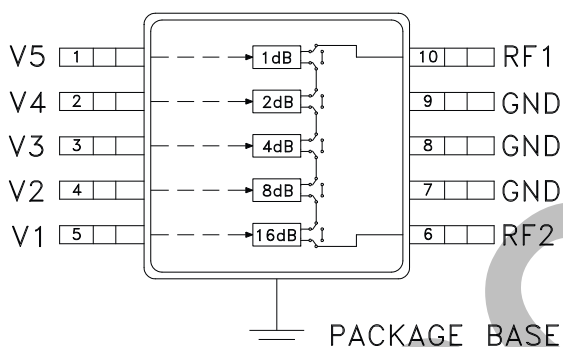
The HMC273MS10G(E) is ideal for:

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

Features

- RoHs Compliant Product
- 1 dB LSB Steps to 31 dB
- Single Positive Control Per BIT
- ±0.2 dB Typical Bit Error
- Miniature MSOP 10 Package: 14.8mm²
- Included in the HMC-DK004 Designer's Kit

Functional Diagram



General Description

The HMC273MS10G(E) is a general purpose broadband 5-Bit positive control GaAs IC digital attenuator in a 10 lead MSOP plastic package. Covering 0.7 to 3.8 GHz, the insertion loss is typically less than 2.5 dB. The attenuator bit values are 1 (LSB), 2, 4, 8, and 16 dB for a total attenuation of 31 dB. Accuracy is excellent at ±0.2 dB typical with an IIP3 of up to +48 dBm. Five bit control voltage inputs, toggled between 0 and +3 to +5 volts, are used to select each attenuation state. A single Vdd bias of +3 to +5 volts applied through an external 5K Ohm resistor is required.

Electrical Specifications,

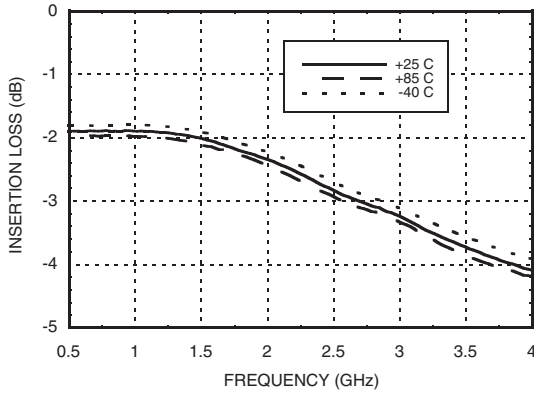
$T_a = +25^\circ\text{C}$, $V_{dd} = +3\text{V to } +5\text{V}$ & $V_{ctl} = 0/V_{dd}$ (Unless Otherwise Stated)

| Parameter | Frequency | Min. | Typical | Max. | Units |
|--|---------------|-------------------------------------|---------|------|-------|
| Insertion Loss | 0.7 - 1.4 GHz | | 1.8 | 2.4 | dB |
| | 1.4 - 2.3 GHz | | 2.3 | 2.9 | dB |
| | 2.3 - 2.7 GHz | | 2.8 | 3.4 | dB |
| | 2.7 - 3.7 GHz | | 3.5 | 4.2 | dB |
| | 3.7 - 3.8 GHz | | 3.9 | 4.4 | dB |
| Attenuation Range | 0.7 - 3.8 GHz | | 31 | | dB |
| Return Loss (RF1 & RF2, All Atten. States) | 0.7 - 1.4 GHz | 11 | 17 | | dB |
| | 1.4 - 2.7 GHz | 12 | 20 | | dB |
| | 2.7 - 3.8 GHz | 10 | 14 | | dB |
| Attenuation Accuracy: (Referenced to Insertion Loss) All Attenuation States All Attenuation States All Attenuation States All Attenuation States | 0.7 - 1.4 GHz | ± (0.30 + 3% of Atten. Setting) Max | | | dB |
| | 1.4 - 2.2 GHz | ± (0.30 + 4% of Atten. Setting) Max | | | dB |
| | 2.2 - 2.7 GHz | ± (0.40 + 5% of Atten. Setting) Max | | | dB |
| | 2.7 - 3.8 GHz | ± (0.50 + 5% of Atten. Setting) Max | | | dB |
| Input Power for 0.1 dB Compression | 0.7 - 3.8 GHz | Vdd = 5V | 27 | | dBm |
| | | Vdd = 3V | 22 | | dBm |
| Input Third Order Intercept Point (Two-tone Input Power = 0 dBm Each Tone) | 0.7 - 3.8 GHz | Vdd = 5V | 48 | | dBm |
| | | Vdd = 3V | 46 | | dBm |
| Switching Characteristics tRISE, tFALL (10/90% RF) tON, tOFF (50% CTL to 10/90% RF) | 0.7 - 3.8 GHz | | 560 | | ns |
| | | | 600 | | ns |
| | | | | | |

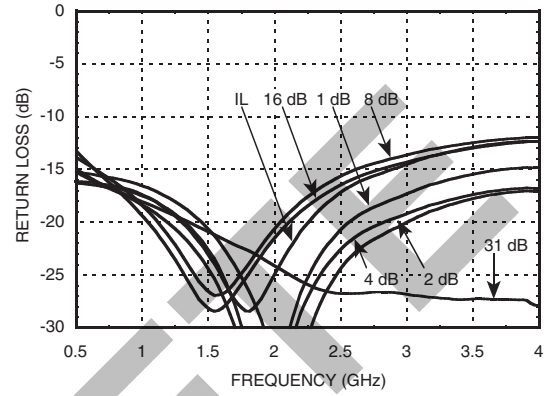
**1 dB LSB GaAs MMIC 5-BIT DIGITAL
ATTENUATOR, 0.7 - 3.8 GHz**



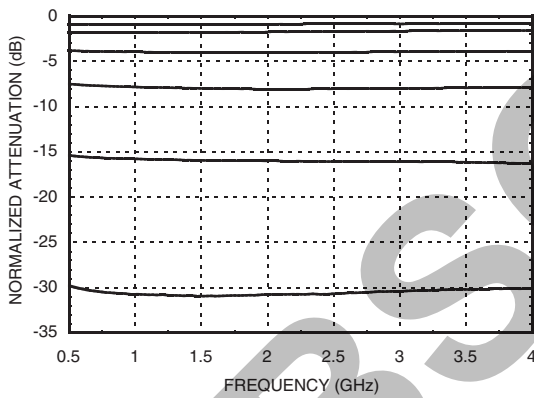
Insertion Loss vs. Temperature



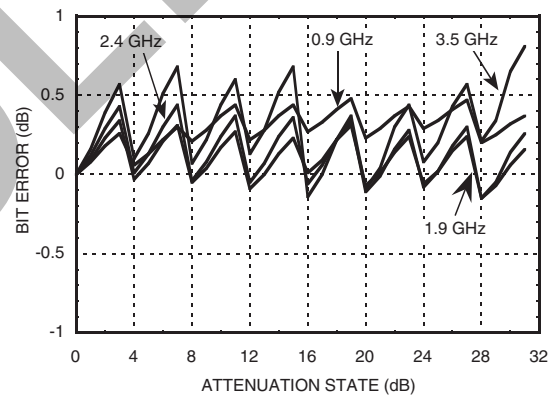
Return Loss RF1, RF2
(Only Major States are Shown)



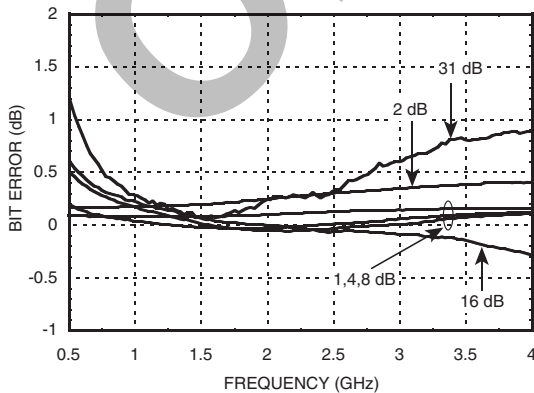
Normalized Attenuation
(Only Major States are Shown)



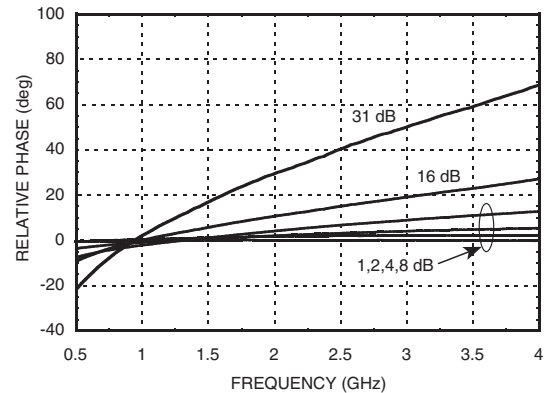
Bit Error vs. Attenuation State



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



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



Note: All Data Typical Over Voltage (+3V to +5V)

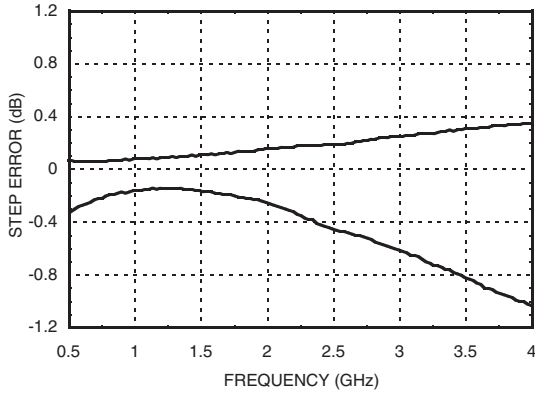
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**1 dB LSB GaAs MMIC 5-BIT DIGITAL
ATTENUATOR, 0.7 - 3.8 GHz**



**Worst Case Step Error
Between Successive Attenuation States**



Truth Table

| Control Voltage Input | | | | | Attenuation Setting RF1 - RF2 |
|-----------------------|------------|------------|------------|------------|----------------------------------|
| V1 16 dB | V2 8 dB | V3 4 dB | V4 2 dB | V5 1 dB | |
| High | High | High | High | High | Reference I.L. |
| High | High | High | High | Low | 1 dB |
| High | High | High | Low | High | 2 dB |
| High | High | Low | High | High | 4 dB |
| High | Low | High | High | High | 8 dB |
| Low | High | High | High | High | 16 dB |
| Low | Low | Low | Low | Low | 31 dB Max. Atten. |

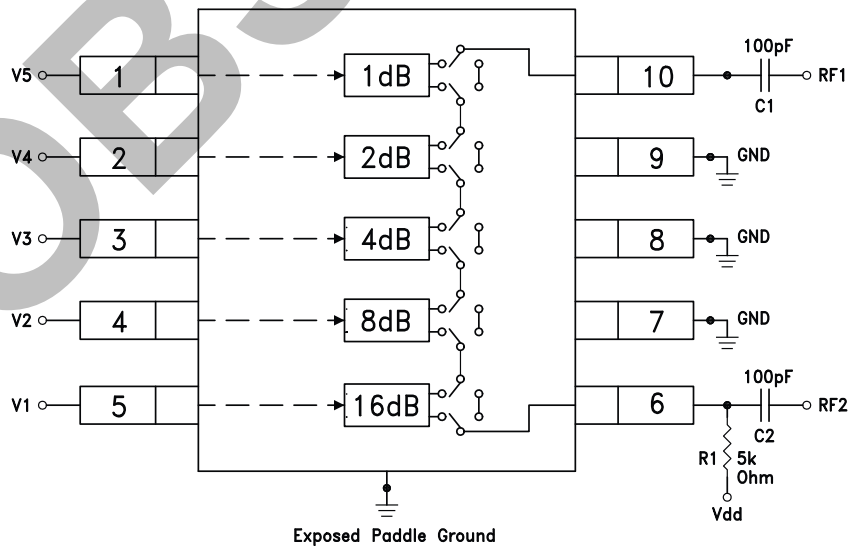
Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

Control Voltages

| State | Bias Condition |
|-------|-------------------------|
| Low | 0 to +0.2 V @ 20 uA Max |
| High | Vdd ± 0.2V @ 100 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 6 or PIN 10.

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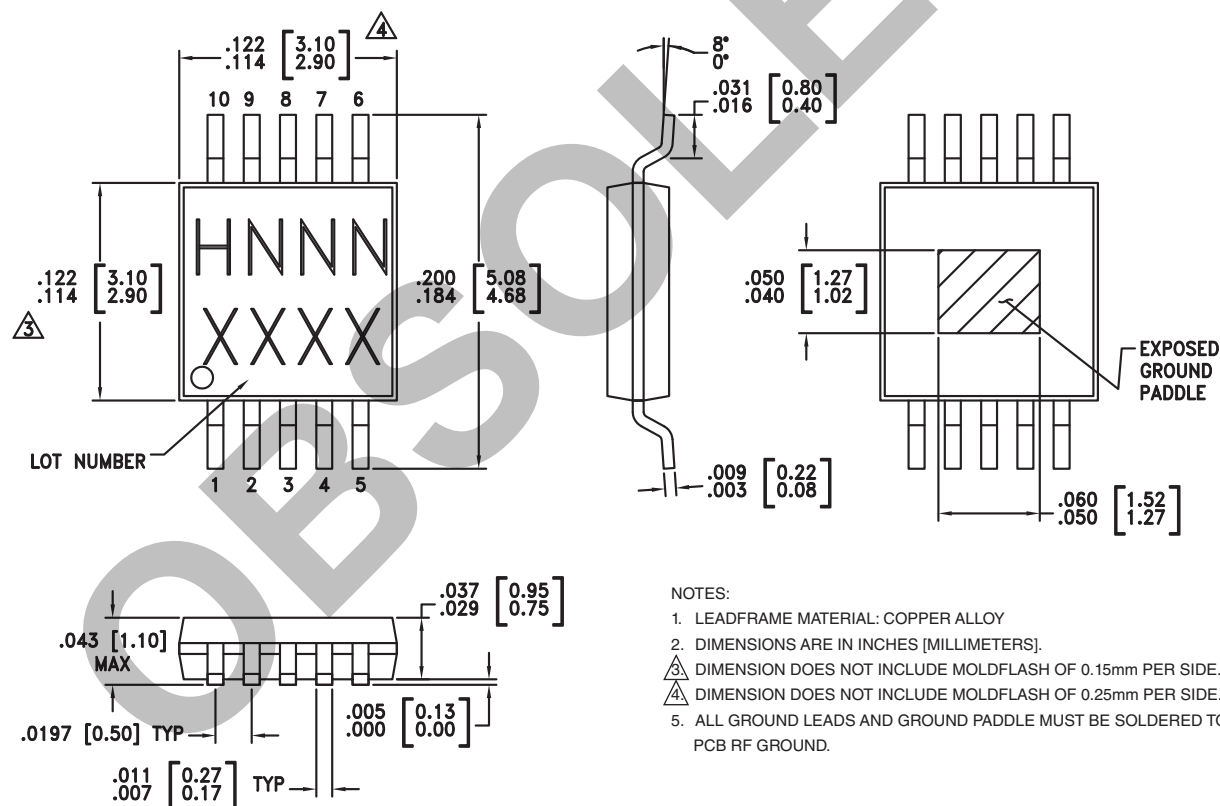
Absolute Maximum Ratings

| | |
|---|----------------|
| Control Voltage (V1 - V5) | Vdd + 0.5 Vdc |
| Bias Voltage (Vdd) | +8.0 Vdc |
| Channel Temperature | 150 °C |
| Continuous P _{diss} (T=85°C) (derate 6mW/°C above 85°C) | 0.4 W |
| Thermal Resistance | 163 °C/W |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -40 to +85 °C |
| RF Input Power (0.7 - 3.7 GHz) | +30 dBm |
| ESD Sensitivity (HBM) | Class 1A |



ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing



Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[3] |
|--------------|--|---------------|---------------------|--------------------------------|
| HMC273MS10G | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 ^[1] | H273 XXXX |
| HMC273MS10GE | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 ^[2] | H273 XXXX |

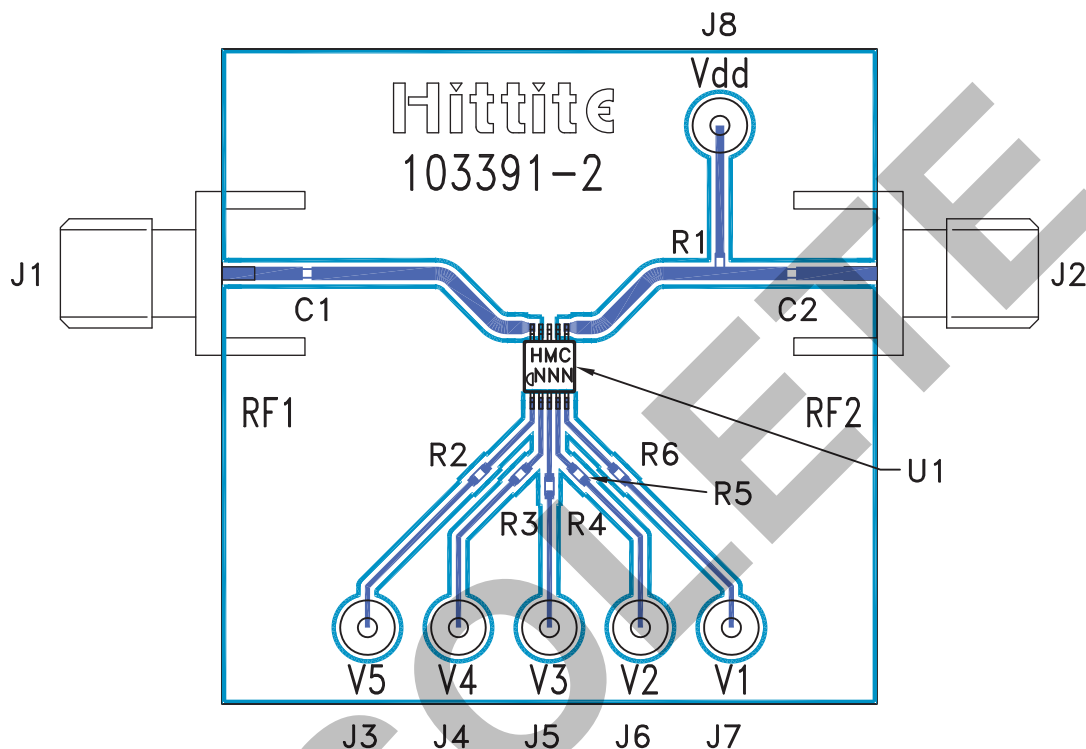
[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX



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 - J6 | DC Pin |
| R1 | 5k Ohm Resistor, 0402 Chip |
| R2, R3, R4 | 100 Ohm Resistor, 0402 Chip |
| C1, C2 | 0402 Chip Capacitor, Select for Lowest Frequency of Operation |
| U1 | HMC273MS10G / HMC273MS10GE Digital Attenuator |
| 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 and exposed ground paddle should be connected directly to the ground plane similar to that shown below. 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:

HMC273MS10G / 273MS10GE

v04.0907

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

OBSOLETE

5

ATTENUATORS - SMT