

## GaAs MMIC VOLTAGE-VARIABLE ATTENUATOR, 1.5 - 2.3 GHz

### Typical Applications

The HMC210MS8 is ideal for:

- Base Station Infrastructure
- Portable Wireless
- MMDS

### Features

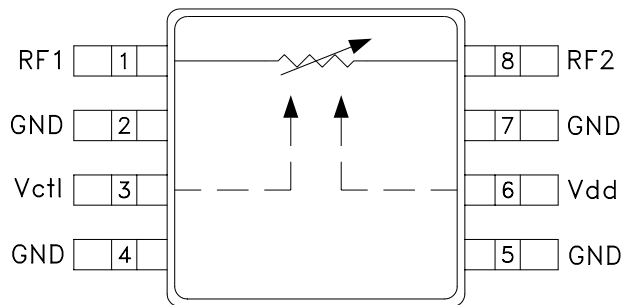
Single Positive Voltage Control: 0 to +2.5V

High Attenuation Range: >50 dB @ 1.9 GHz

High Input IP3: +15 dBm Typical  
(All Attenuation States)

Ultra Small Package: MSOP

### Functional Diagram



### General Description

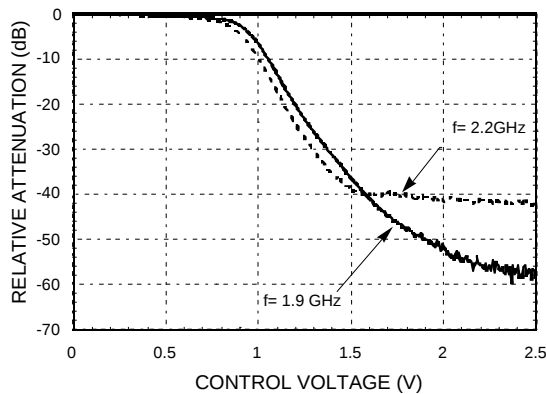
The HMC210MS8 is a miniature absorptive voltage variable attenuator in an 8-lead MSOP package. The device operates with a positive supply voltage (+2.5V), and a positive control voltage. A unique feature is the high third order intercept point for all attenuation states. Operation up to 2.3 GHz is possible with a reduced attenuation range of 31 dB.

### Electrical Specifications, $T_A = +25^\circ\text{C}$ , $V_{dd} = +2.5\text{ Vdc}$ , 50 Ohm System

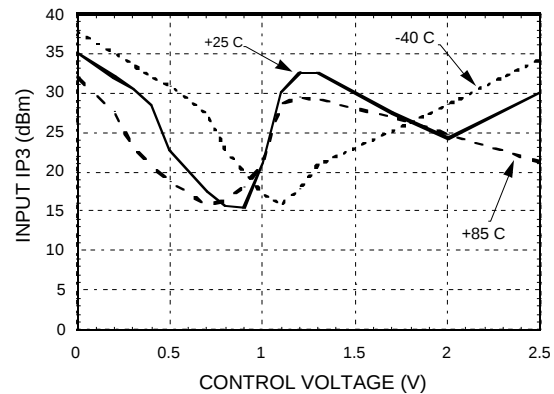
| Parameter                                                                                 | Condition                 | Min.     | Typical  | Max. | Units         |
|-------------------------------------------------------------------------------------------|---------------------------|----------|----------|------|---------------|
| Insertion Loss<br>(VCTL = 0 V Min. Atten.)                                                | 1.8 - 2.0 GHz             |          | 3.3      | 4.9  | dB            |
|                                                                                           | 1.7 - 2.1 GHz             |          | 3.4      | 5.5  | dB            |
|                                                                                           | 1.5 - 2.3 GHz             |          | 5.0      | 7.5  | dB            |
| Attenuation Range<br>(VCTL = 0 to +2.5 V)                                                 | 1.8 - 2.0 GHz             | 44       | 55       |      | dB            |
|                                                                                           | 1.7 - 2.1 GHz             | 39       | 43       |      | dB            |
|                                                                                           | 1.5 - 2.3 GHz             | 31       | 40       |      | dB            |
| Return Loss<br>(VCTL = 0 to +2.5 V)                                                       | 1.5 - 2.0 GHz             |          | 9        |      | dB            |
|                                                                                           | 2.0 - 2.3 GHz             |          | 6        |      | dB            |
| Input Power for 0.1 dB Compression<br>(f = 1.9 GHz)                                       | Min Atten.<br>Atten. >2.0 |          | 15<br>-5 |      | dBm<br>dBm    |
| Input Power for 1.0 dB Compression<br>(f = 1.9 GHz)                                       | Min Atten.<br>Atten. >2.0 | 17<br>0  | 20<br>3  |      | dBm<br>dBm    |
| Input Third Order Intercept<br>(f = 1.9 GHz, Two-tone Input Power = +5 dBm Each Tone)     | Min Atten.<br>Atten. >2.0 | 30<br>10 | 35<br>15 |      | dBm<br>dBm    |
| Switching Characteristics<br>tRISE, tFALL (10/90% RF)<br>tON, tOFF (50% CTL to 10/90% RF) | 1.5 - 2.3 GHz             |          | 0.9      |      | $\mu\text{S}$ |
|                                                                                           |                           |          | 2.6      |      | $\mu\text{S}$ |
|                                                                                           |                           |          |          |      |               |

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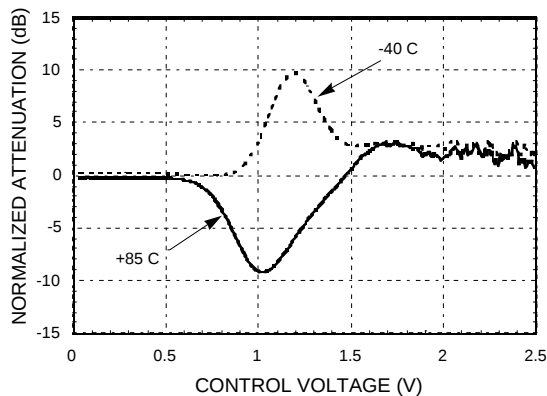
**Relative Attenuation vs.  
Control Voltage @ 1.9 and 2.2 GHz**



**Input IP3 vs.  
Control Voltage @ 1.9 GHz**



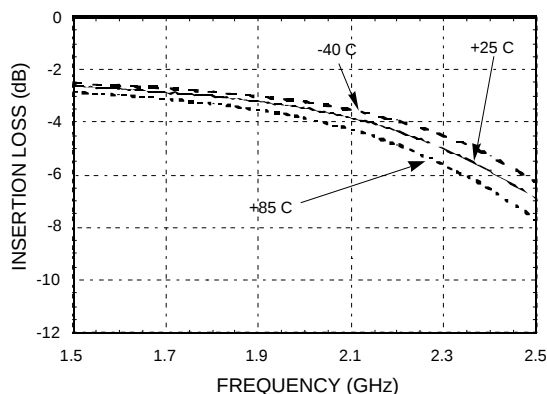
**Attenuation vs. Temperature  
Normalized to +25° C @ 1.9 GHz**



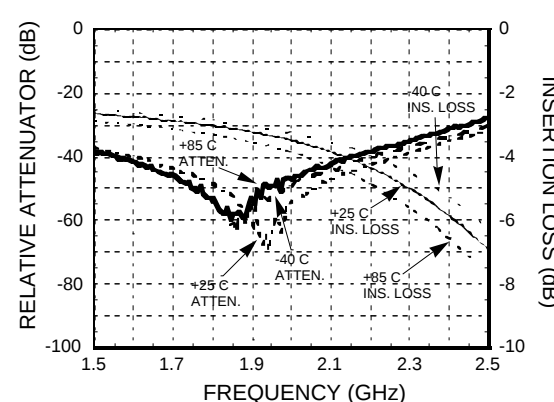
**Typical Input P1dB Compression  
@ 1.9 GHz vs. Temperature**

| Input Power for 1 dB Compression Point |               |              |      |      |      |       |
|----------------------------------------|---------------|--------------|------|------|------|-------|
| Test Condition<br>(1.9 GHz)            | VCTL<br>(Vdc) | Vdd<br>(Vdc) | +25C | +85C | -40C | Units |
| Min.<br>Attenuation                    | 0.0           | +2.5         | 20   | 20   | 21   | dBm   |
| Max.<br>Attenuation                    | +2.5          | +2.5         | 19   | 16   | 25   | dBm   |
| Worst Case<br>P1dB                     | +1.0          | +2.5         | 3    | 4    | 3    | dBm   |

**Broadband Insertion Loss**



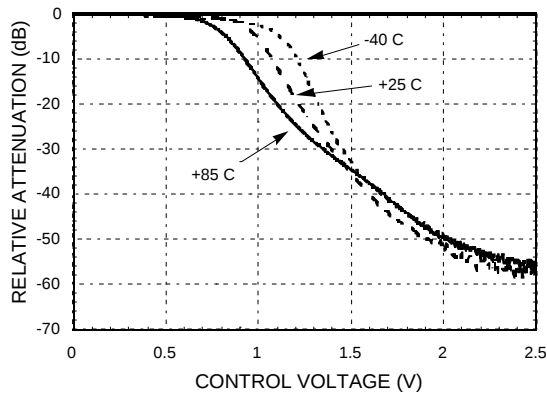
**Broadband Maximum Relative  
Attenuation and Return Loss**



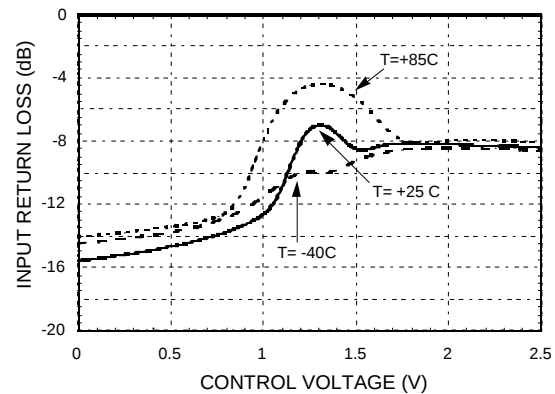
## GaAs MMIC VOLTAGE-VARIABLE ATTENUATOR, 1.5 - 2.3 GHz

### Typical Performance for 1.9 GHz Applications

**Attenuation vs.  
Control Voltage @ 1.9 GHz**

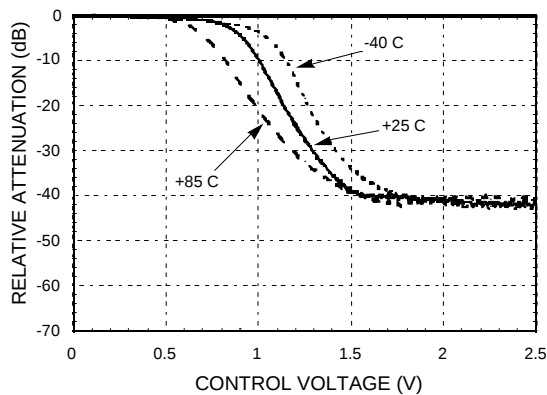


**Return Loss vs.  
Control Voltage @ 1.9 GHz**

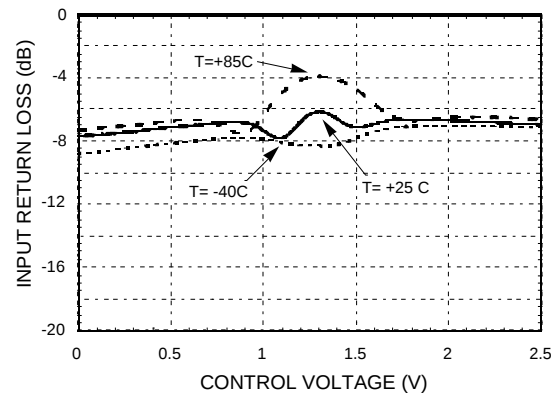


### Typical Performance for 2.2 GHz Applications

**Attenuation vs.  
Control Voltage @ 2.2 GHz**



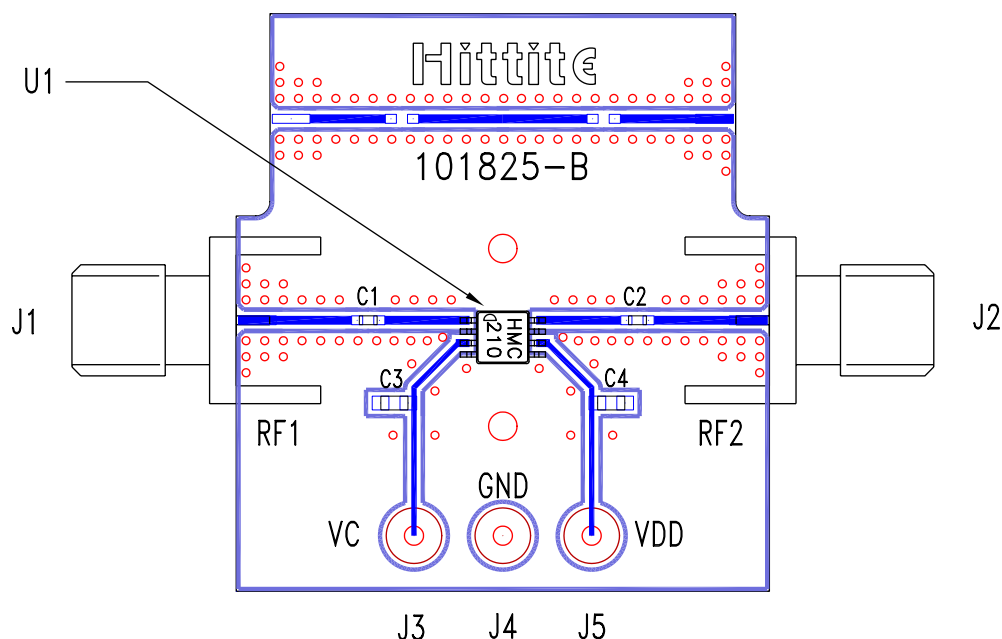
**Return Loss vs.  
Control Voltage @ 2.2 GHz**





## GaAs MMIC VOLTAGE-VARIABLE ATTENUATOR, 1.5 - 2.3 GHz

### Evaluation Circuit Board



### List of Material

| Item                                 | Description                       |
|--------------------------------------|-----------------------------------|
| J1, J2                               | PC Mount SMA RF Connector         |
| J3 - J5                              | DC PIN                            |
| C1, C2                               | 330 pF capacitor, 0402 package    |
| C3, C4                               | 10,000 pF capacitor, 0603 package |
| U1                                   | HMC210MS8 VVA                     |
| PCB*                                 | 101825 Eval Board                 |
| *Circuit Board Material: Rogers 4350 |                                   |

The circuit board used in the final application should be generated with proper RF circuit design techniques. Signal lines at the RF ports should be 50 ohm impedance and the package ground leads and package bottom should be connected directly to the PCB RF ground plane, similar to that shown above. The evaluation circuit board shown above is available from Hittite Microwave Corporation upon request.

## *GaAs MMIC VOLTAGE-VARIABLE ATTENUATOR, 1.5 - 2.3 GHz*

### **Notes:**