MAAT-010521-H1

Voltage Variable Attenuator
17.6 - 40 GHz

Rev. V2

Features
- 17.6 - 40 GHz Frequency Range
- 2 dB Insertion Loss @ 24 GHz
- >30 dB Attenuation Range
- High Linearity, 29 dBm IIP3
- Lead-Free 3 mm, 16-Lead QFN Package
- RoHS* Compliant

Description
The MAAT-010521-H1 is a voltage variable attenuator with analog control and greater than 30 dB of attenuation. Excellent linearity is maintained over the full attenuation range. The attenuation level is set by two control voltages of 0 to -2 V. This device is assembled in a lead free 3 mm 16 lead PQFN plastic package.

Applications include transceivers for cellular infrastructure.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAT-010521-H1TR05</td>
<td>500 Part Reel</td>
</tr>
<tr>
<td>MAAT-010521-H1TR1K</td>
<td>1000 Part Reel</td>
</tr>
<tr>
<td>MAAT-010521-H1BSMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts.

Functional Block Diagram

Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Connection</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>RF Input</td>
</tr>
<tr>
<td>4</td>
<td>Ground</td>
</tr>
<tr>
<td>5</td>
<td>No Connection</td>
</tr>
<tr>
<td>6</td>
<td>Vc1</td>
</tr>
<tr>
<td>7</td>
<td>Vc2</td>
</tr>
<tr>
<td>8</td>
<td>No Connection</td>
</tr>
<tr>
<td>9</td>
<td>Ground</td>
</tr>
<tr>
<td>10</td>
<td>RF Output</td>
</tr>
<tr>
<td>11</td>
<td>Ground</td>
</tr>
<tr>
<td>12 - 16</td>
<td>No Connection</td>
</tr>
</tbody>
</table>

3. It is recommended to connect unused pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.


MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. Visit www.macom.com for additional data sheets and product information.

For further information and support please visit: https://www.macom.com/support

DC-0014411
Voltage Variable Attenuator
17.6 - 40 GHz

Electrical Specifications: \( T_A = +25^\circ C, Z_0 = 50 \Omega, P_{IN} = -10 \text{ dBm} \)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
</table>
| Insertion Loss \((V_{C1} \text{ and } V_{C2} = -2 \text{ V})\) | 17.6 - 23.7 GHz  
24 - 40 GHz | dB | 2 | 3 | 6 |
| Attenuation \((V_{C1} \text{ and } V_{C2} = 0 \text{ V})^5\) | 17.6 - 40 GHz | dB | 30 | 35 | — |
| Dynamic Range | 17.6 - 19.8 GHz  
21.1 - 23.7 GHz  
24.25 - 29.5 GHz  
31.8 - 33.4 GHz  
37 - 40 GHz | dB | 32 | 35 | — |
| Input P1dB\(^6\) \((V_{C1} \text{ and } V_{C2} = -2 \text{ V})\) | 17.6 - 23.7 GHz  
24 - 40 GHz | dBm | 23 | 27 | — |
| IIP3 (any attenuation) | \(P_{IN} = 12 \text{ dBm/tone @ 17.6 - 23.7 GHz} \)  
\(P_{IN} = 12 \text{ dBm/tone @ 24 - 40 GHz} \) | dBm | 27.5 | 29.5 | — |
| IIP3 \((V_{C1}=V_{C2}=-2 \text{ V})\) | \(P_{IN} = 12 \text{ dBm/tone @ 17.6 - 40 GHz} \) | dBm | 35 | 42 | — |
| Input Return Loss | Any Attenuation | dB | — | 10 | — |
| Output Return Loss | Any Attenuation | dB | — | 10 | — |

5. To increase attenuation from minimum attenuation state \((V_{C1} = -2 \text{ V} \text{ and } V_{C2} = -2 \text{ V})\) to max attenuation state \((V_{C1} = 0 \text{ V} \text{ and } V_{C2} = 0 \text{ V})\), \(V_{C1}\) increases to full range prior to adjusting \(V_{C2}\).
6. Guaranteed on MACOM sample board.

Absolute Maximum Ratings\(^7,8\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>30 dBm</td>
</tr>
<tr>
<td>Voltage (RF pins)</td>
<td>30 V</td>
</tr>
<tr>
<td>Voltage (control pins)</td>
<td>+1 V to -6 V</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-55°C to +150°C</td>
</tr>
<tr>
<td>Case Temperature</td>
<td>-40°C to +85°C</td>
</tr>
</tbody>
</table>

Handling Procedures
The following precautions should be observed to avoid damage:

Static Sensitivity
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A devices.

For further information and support please visit:
https://www.macom.com/support
Typical Performance Curves: @ +25°C

**Gain**

-50, -45, -40, -35, -30, -25, -20, -15, -10, 0

**Input Return Loss**

-40, -35, -30, -25, -20, -15, -10, 0

**Output Return Loss**

-40, -35, -30, -25, -20, -15, -10, 0

**Dynamic Range**

-50, -45, -40, -35, -30, -25, -20, -15

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.

For further information and support please visit: [https://www.macom.com/support](https://www.macom.com/support)
Typical Performance Curves: S-Parameters @ +25°C

S-Parameters $V_C1 = -2.0$ V, $V_C2 = -2.0$ V

S-Parameters $V_C1 = -0.6$ V, $V_C2 = -2.0$ V

S-Parameters $V_C1 = -0.4$ V, $V_C2 = -2.0$ V

S-Parameters $V_C1 = -0.1$ V, $V_C2 = -2.0$ V

S-Parameters $V_C1 = 0$ V, $V_C2 = -0.6$ V
Typical Performance Curves: Power Gain @ +25°C

Power Gain @ \( V_{C1} = -2.0 \, \text{V}, \, V_{C2} = -2.0 \, \text{V} \)

Power Gain @ \( V_{C1} = 0 \, \text{V}, \, V_{C2} = -2.0 \, \text{V} \)

Power Gain @ \( V_{C1} = -0.4 \, \text{V}, \, V_{C2} = -2.0 \, \text{V} \)

Power Gain @ \( V_{C1} = 0 \, \text{V}, \, V_{C2} = -0.6 \, \text{V} \)

Power Gain @ \( V_{C1} = 0 \, \text{V}, \, V_{C2} = 0 \, \text{V} \)
Voltage Variable Attenuator
17.6 - 40 GHz

Typical Performance Curves: Input IP3

**Input IP3 vs. Frequency**
@ \( V_{C1} = -2.0 \) V, \( V_{C2} = -2.0 \) V

**Input IP3 vs. SCL Input Power**
@ \( V_{C1} = -2.0 \) V, \( V_{C2} = -2.0 \) V

**Input IP3 vs. Attenuation, SCL \( P_{IN} = 6 \) dBm

**Input IP3 vs. Attenuation, SCL \( P_{IN} = 12 \) dBm

For further information and support please visit:
[https://www.macom.com/support](https://www.macom.com/support)

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.
**Lead-Free 3 mm 16-Lead PQFN†**

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is NiPdAuAg.

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.
Visit www.macom.com for additional data sheets and product information.

For further information and support please visit:
https://www.macom.com/support
MACOM Technology Solutions Inc. All rights reserved.
Information in this document is provided in connection with MACOM Technology Solutions Inc ("MACOM") products. These materials are provided by MACOM as a service to its customers and may be used for informational purposes only. Except as provided in MACOM’s Terms and Conditions of Sale for such products or in any separate agreement related to this document, MACOM assumes no liability whatsoever. MACOM assumes no responsibility for errors or omissions in these materials. MACOM may make changes to specifications and product descriptions at any time, without notice. MACOM makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppels or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MACOM FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MACOM SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.