Voltage Variable Attenuator
5.8 - 16 GHz

Features
- 5.8 - 16 GHz Frequency Range
- 2.0 dB Insertion Loss @ 10 GHz
- >30 dB Attenuation Range
- High Linearity, 30 dBm IIP3
- Lead-Free 3 mm, 16-Lead QFN Package
- RoHS* Compliant

Description
The MAAT-010521-L1 is a voltage variable attenuator with analog control and >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-L1TR05</td>
<td>500 Part Reel</td>
</tr>
<tr>
<td>MAAT-010521-L1TR1K</td>
<td>1000 Part Reel</td>
</tr>
<tr>
<td>MAAT-010521-L1BSMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

Functional Block Diagram

Pin Configuration\(^1,2\)

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 5, 8, 12 - 16</td>
<td>No Connection</td>
</tr>
<tr>
<td>2, 4, 9, 11</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>RF Input</td>
</tr>
<tr>
<td>6</td>
<td>V(_{C1})</td>
</tr>
<tr>
<td>7</td>
<td>V(_{C2})</td>
</tr>
<tr>
<td>10</td>
<td>RF Output</td>
</tr>
</tbody>
</table>

1. It is recommended to connect No Connection (N/C) pins to ground.
2. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.
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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>
<tbody>
<tr>
<td>Insertion Loss ($V_{C1} = V_{C2} = -2 , \text{V}$)</td>
<td>5.8 - 7.1 GHz, 7.1 - 8.5 GHz, 10.0 - 12.0 GHz, 12.7 - 15.4 GHz</td>
<td>dB</td>
<td>—</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Attenuation ($V_{C1} = V_{C2} = 0 , \text{V}$)</td>
<td>5.8 - 7.1 GHz, 7.1 - 8.5 GHz, 10.0 - 12.0 GHz, 12.7 - 15.4 GHz</td>
<td>dB</td>
<td>—</td>
<td>26.0</td>
<td>—</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>5.8 - 7.1 GHz, 7.1 - 8.5 GHz, 10.0 - 12.0 GHz, 12.7 - 15.4 GHz</td>
<td>dB</td>
<td>—</td>
<td>24.0</td>
<td>—</td>
</tr>
<tr>
<td>Input P1dB$^4$</td>
<td>5.8 - 15.4 GHz</td>
<td>dBm</td>
<td>20.0</td>
<td>23.0</td>
<td>—</td>
</tr>
<tr>
<td>IIP3</td>
<td>$P_{IN} = 10 , \text{dBm/tone} @ 5.8 - 15.4 , \text{GHz}$, $V_{C1} = 0 , \text{V} , &amp; , V_{C2} &gt; -0.8 , \text{V}$, $V_{C1} \leq 0 , \text{V} , &amp; , V_{C2} \leq -0.8 , \text{V}$, $V_{C1} = V_{C2} = -2 , \text{V}$</td>
<td>dBm</td>
<td>27.8</td>
<td>29.0</td>
<td>32.0</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>10.0</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>10.0</td>
<td>—</td>
</tr>
</tbody>
</table>

3. To increase attenuation from minimum attenuation state ($V_{C1} = -2 \, \text{V} \, \& \, V_{C2} = -2 \, \text{V}$) to maximum attenuation state ($V_{C1} = 0 \, \text{V} \, \& \, V_{C2} = 0 \, \text{V}$), $V_{C1}$ increases to full range prior to adjusting $V_{C2}$. Typical attenuation measured on MACOM Sample Board in state: $V_{C1} = 0 \, \text{V} \, \& \, V_{C2} = -0.8 \, \text{V}$ is 20.5 dB for 12.7 - 15.4 GHz band.
4. Guaranteed on MACOM Sample Board only.

Absolute Maximum Ratings$^{5,6}$

<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>

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.

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.
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Typical Performance Curves: @ +25°C

**Gain**

![Gain Graph]

**Output Return Loss**

![Output Return Loss Graph]

**Input Return Loss**

![Input Return Loss Graph]

**Dynamic Range**

![Dynamic Range Graph]
Typical Performance Curves: S-Parameters @ +25°C

S-Parameters V\textsubscript{C1} = -2.0 V, V\textsubscript{C2} = -2.0 V

S-Parameters V\textsubscript{C1} = -0.6 V, V\textsubscript{C2} = -2.0 V

S-Parameters V\textsubscript{C1} = -0.2 V, V\textsubscript{C2} = -2.0 V

S-Parameters V\textsubscript{C1} = 0 V, V\textsubscript{C2} = -0.6 V
Typical Performance Curves: Power Gain @ +25°C

**Power Gain @ $V_{C1} = -2.0 \, V$, $V_{C2} = -2.0 \, V$**

![Graph for $V_{C1} = -2.0 \, V$, $V_{C2} = -2.0 \, V$]

**Power Gain @ $V_{C1} = 0 \, V$, $V_{C2} = -2.0 \, V$**

![Graph for $V_{C1} = 0 \, V$, $V_{C2} = -2.0 \, V$]

**Power Gain @ $V_{C1} = -0.4 \, V$, $V_{C2} = -2.0 \, V$**

![Graph for $V_{C1} = -0.4 \, V$, $V_{C2} = -2.0 \, V$]

**Power Gain @ $V_{C1} = 0 \, V$, $V_{C2} = -0.6 \, V$**

![Graph for $V_{C1} = 0 \, V$, $V_{C2} = -0.6 \, V$]

**Power Gain @ $V_{C1} = 0 \, V$, $V_{C2} = 0 \, V$**

![Graph for $V_{C1} = 0 \, V$, $V_{C2} = 0 \, V$]
Typical Performance Curves: Input IP3

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

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

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

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