MAAD-007086

Digital Attenuator
50 dB, 6-Bit, TTL Driver, DC - 2.0 GHz

Features
- Attenuation: 1 dB Steps to 50 dB
- Low DC Power Consumption
- Integral TTL Driver
- 50 ohm Impedance
- Test Boards are Available
- Tape and Reel Packaging Available
- Lead-Free SOW-24 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free “Green” Mold Compound
- 260°C Reflow Compatible
- RoHS* Compliant Version of AT65-0106

Description
MACOM's MAAD-007086-000100 is a GaAs FET 6-bit digital attenuator with a 1 dB minimum step size and a 50 dB total attenuation range. This device is in a SOW-24, wide body plastic surface mount package. The MAAD-007086-000100 is ideally suited for use where accuracy, fast speed, very low power consumption and low costs are required.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAD-007086-000100</td>
<td>Bulk Packaging</td>
</tr>
<tr>
<td>MAAD-007086-0001TR</td>
<td>1000 piece reel</td>
</tr>
<tr>
<td>MAAD-007086-0001TB</td>
<td>Sample Test Board</td>
</tr>
</tbody>
</table>

Note: Reference Application Note M513 for reel size information.

Schematic with Off-Chip Components

Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>13</td>
<td>RF</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>14</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>15</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>C32</td>
<td>16</td>
<td>GND</td>
</tr>
<tr>
<td>5</td>
<td>C16</td>
<td>17</td>
<td>GND</td>
</tr>
<tr>
<td>6</td>
<td>VEE</td>
<td>18</td>
<td>GND</td>
</tr>
<tr>
<td>7</td>
<td>VCC</td>
<td>19</td>
<td>GND</td>
</tr>
<tr>
<td>8</td>
<td>C8</td>
<td>20</td>
<td>GND</td>
</tr>
<tr>
<td>9</td>
<td>C4</td>
<td>21</td>
<td>GND</td>
</tr>
<tr>
<td>10</td>
<td>C2</td>
<td>22</td>
<td>GND</td>
</tr>
<tr>
<td>11</td>
<td>C1</td>
<td>23</td>
<td>GND</td>
</tr>
<tr>
<td>12</td>
<td>GND</td>
<td>24</td>
<td>RF</td>
</tr>
</tbody>
</table>

Digital Attenuator
50 dB, 6-Bit, TTL Driver, DC - 2.0 GHz

Electrical Specifications: \( T_A = 25^\circ C, Z_0 = 50\Omega \)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Frequency</th>
<th>Units</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>—</td>
<td>DC - 2.0 GHz</td>
<td>dB</td>
<td>—</td>
<td>4.2</td>
<td>4.7</td>
</tr>
<tr>
<td>Attenuation Accuracy</td>
<td>Individual Bits 1-2-4-8-16-32 dB</td>
<td>DC - 2.0 GHz</td>
<td>dB</td>
<td>—</td>
<td>—</td>
<td>±(3 +3% of atten setting)</td>
</tr>
<tr>
<td></td>
<td>Any Combination of Bits 3 to 15 dB</td>
<td>DC - 2.0 GHz</td>
<td>dB</td>
<td>—</td>
<td>—</td>
<td>±(5 +5% of atten setting)</td>
</tr>
<tr>
<td></td>
<td>Any Combination of Bits 17 to 31 dB</td>
<td>DC - 2.0 GHz</td>
<td>dB</td>
<td>—</td>
<td>—</td>
<td>±(3 +3% of atten setting)</td>
</tr>
<tr>
<td></td>
<td>Any Combination of Bits 32 to 50 dB</td>
<td>DC - 2.0 GHz</td>
<td>dB</td>
<td>—</td>
<td>—</td>
<td>±(5 +7% of atten setting)</td>
</tr>
<tr>
<td>VSWR</td>
<td>Full Range</td>
<td>DC - 2.0 GHz</td>
<td>Ratio</td>
<td>—</td>
<td>1.8:1</td>
<td>2:1</td>
</tr>
<tr>
<td>Switching Speed(^1)</td>
<td>50% Cntl to 90%/10% RF</td>
<td>—</td>
<td>ns</td>
<td>—</td>
<td>75</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>10% to 90% or 90% to 10%</td>
<td>—</td>
<td>ns</td>
<td>—</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>1 dB Compression</td>
<td>Two-tone inputs up to +5 dBm @ 0 dB Attenuation</td>
<td>50 MHz</td>
<td>dbm</td>
<td>—</td>
<td>+21</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5-2.0 GHz</td>
<td>dbm</td>
<td>—</td>
<td>+24</td>
<td>—</td>
</tr>
<tr>
<td>Input IP(_3)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Vcc</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>4.75</td>
<td>5.0</td>
<td>5.25</td>
</tr>
<tr>
<td>Vee</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td>-8.0</td>
<td>-5.0</td>
<td>-4.75</td>
</tr>
<tr>
<td>V(_L)</td>
<td>LOW-level input voltage</td>
<td>—</td>
<td>V</td>
<td>0.0</td>
<td>—</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>HIGH-level input voltage</td>
<td>—</td>
<td>V</td>
<td>2.0</td>
<td>—</td>
<td>5.0</td>
</tr>
<tr>
<td>V(_H)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Il (Input Leakage Current)</td>
<td>Vin = V(_CC) or GND</td>
<td>—</td>
<td>uA</td>
<td>-1.0</td>
<td>—</td>
<td>1.0</td>
</tr>
<tr>
<td>Icc (Quiescent Supply Current)</td>
<td>Vcntrl = V(_CC) or GND</td>
<td>—</td>
<td>uA</td>
<td>—</td>
<td>250</td>
<td>400</td>
</tr>
<tr>
<td>(\Delta)Icc (Additional Supply Current Per TTL Input Pin)</td>
<td>V(_CC) = Max, Vcntrl = V(_CC) - 2.1 V</td>
<td>—</td>
<td>mA</td>
<td>—</td>
<td>—</td>
<td>1.0</td>
</tr>
<tr>
<td>IEE</td>
<td>Vee min to max, Vin = V(_L) or V(_H)</td>
<td>—</td>
<td>mA</td>
<td>-1.0</td>
<td>-0.2</td>
<td>—</td>
</tr>
<tr>
<td>Thermal Resistance (\theta_{JA})</td>
<td>PCB mount on FR4 material, copper trace, still air at +25°C</td>
<td>—</td>
<td>°C/W</td>
<td>60-80</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

1. Decoupling capacitors (.01µF) are required on power supply lines.

Absolute Maximum Ratings\(^2,3\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Input Power</td>
<td>+27 dBm</td>
</tr>
<tr>
<td></td>
<td>+34 dBm</td>
</tr>
<tr>
<td>0.05 GHz</td>
<td></td>
</tr>
<tr>
<td>0.5 - 2.0 GHz</td>
<td></td>
</tr>
<tr>
<td>V(_CC)</td>
<td>-0.5V ≤ V(_CC) ≤ +7.0V</td>
</tr>
<tr>
<td>V(_EE)</td>
<td>-8.5V ≤ V(_EE) ≤ +0.5V</td>
</tr>
<tr>
<td>V(_CC) - V(_EE)</td>
<td>-0.5V ≤ V(_CC) - V(_EE) ≤ 14.5V</td>
</tr>
<tr>
<td>Vin(^4)</td>
<td>-0.5V ≤ Vin ≤ V(_CC) + 0.5V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +125°C</td>
</tr>
</tbody>
</table>

2. Exceeding any one or combination of these limits may cause permanent damage to this device.
3. MACOM does not recommend sustained operation near these survivability limits.
4. Standard CMOS TTL interface, latch-up will occur if logic signal is applied prior to power supply.

Handling Procedures

Please observe the following precautions 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 devices.
Truth Table (Digital Attenuator)

<table>
<thead>
<tr>
<th>C32</th>
<th>C16</th>
<th>C8</th>
<th>C4</th>
<th>C2</th>
<th>C1</th>
<th>Attenuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Loss, Reference</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1 dB</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2 dB</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4 dB</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8 dB</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16 dB</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>50 dB</td>
</tr>
</tbody>
</table>

0 = TTL Low; 1 = TTL High

Typical Performance Curves

*Insertion Loss vs. Temperature*

1 dB Attenuation Variation from -40°C to +85°C

2 dB Attenuation Variation from -40°C to +85°C

4 dB Attenuation Variation from -40°C to +85°C
Typical Performance Curves

8 dB Attenuation Variation from -40°C to +85°C

16 dB Attenuation Variation from -40°C to +85°C

32 dB Attenuation Variation from -40°C to +85°C

Max. Attenuation Variation from -40°C to +85°C

Reference Loss VSWR (S11, S22)

1 dB VSWR (S11, S22)
Digital Attenuator
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Typical Performance Curves

2 dB VSWR (S11, S22)

4 dB VSWR (S11, S22)

8 dB VSWR (S11, S22)

16 dB VSWR (S11, S22)

32 dB VSWR (S11, S22)

50 dB VSWR (S11, S22)
**Digital Attenuator**

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**Lead-Free, SOW-24†**

NOTES:
1. REFERENCE JEDEC MS-013-AA FOR ADDITIONAL DIMENSIONAL AND TOLERANCE INFORMATION.
2. ALL DIMENSIONS SHOWN AS IN/MM.
3. REFERENCE M538 APPLICATION NOTE FOR PCB FOOTPRINT INFORMATION.

† Reference Application Note M538 for lead-free solder reflow recommendations.
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