Features
- Attenuation: 1 dB Steps to 15 dB
- Low DC Power Consumption
- Small Footprint, JEDEC Package
- Integral TTL Driver
- 50 Ohm Impedance
- Test Boards Available
- Tape and Reel Packaging Available
- Lead-Free CSP-1 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free “Green” Mold Compound
- 260°C Reflow Compatible
- RoHS* Compliant Version of AT90-0413

Description
M/A-COM’s MAADCC0006 is a GaAs FET 4-Bit digital attenuator with integral driver. Step size is 1 dB providing a 15 dB attenuation range. This device is in an PQFN plastic surface mount package. The MAADCC0006 is suited for applications where accuracy, fast speed, 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>MAADCC0006</td>
<td>Bulk Packaging</td>
</tr>
<tr>
<td>MAADCC0006TR</td>
<td>1000 piece reel</td>
</tr>
<tr>
<td>MAADCC0006-TB</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>17</td>
<td>N/C</td>
</tr>
<tr>
<td>2</td>
<td>C8</td>
<td>18</td>
<td>N/C</td>
</tr>
<tr>
<td>3</td>
<td>C4</td>
<td>19</td>
<td>N/C</td>
</tr>
<tr>
<td>4</td>
<td>C2</td>
<td>20</td>
<td>N/C</td>
</tr>
<tr>
<td>5</td>
<td>C1</td>
<td>21</td>
<td>N/C</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>22</td>
<td>N/C</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
<td>23</td>
<td>N/C</td>
</tr>
<tr>
<td>8</td>
<td>N/C</td>
<td>24</td>
<td>N/C</td>
</tr>
<tr>
<td>9</td>
<td>N/C</td>
<td>25</td>
<td>N/C</td>
</tr>
<tr>
<td>10</td>
<td>N/C¹</td>
<td>26</td>
<td>GND</td>
</tr>
<tr>
<td>11</td>
<td>GND</td>
<td>27</td>
<td>RF2</td>
</tr>
<tr>
<td>12</td>
<td>RF1</td>
<td>28</td>
<td>GND</td>
</tr>
<tr>
<td>13</td>
<td>GND</td>
<td>29</td>
<td>N/C¹</td>
</tr>
<tr>
<td>14</td>
<td>N/C</td>
<td>30</td>
<td>Vee</td>
</tr>
<tr>
<td>15</td>
<td>N/C</td>
<td>31</td>
<td>N/C</td>
</tr>
<tr>
<td>16</td>
<td>N/C</td>
<td>32</td>
<td>+Vcc</td>
</tr>
</tbody>
</table>

¹ Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

1. Pins 10 & 29 must be isolated.
2. The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)
**Digital Attenuator**
15.0 dB, 4-Bit, TTL Driver, DC-4.0 GHz

**MAADCC0006**

**Electrical Specifications:** $T_A = 25^\circ C$

<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-2.5 GHz</td>
<td>dB</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DC-4.0 GHz</td>
<td>dB</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attenuation Accuracy</td>
<td>Individual Bits or Combination</td>
<td>DC-2.5 GHz</td>
<td>dB</td>
<td></td>
<td></td>
<td>±(0.3+4% of atten setting)</td>
</tr>
<tr>
<td></td>
<td>of Bits</td>
<td>DC-4.0 GHz</td>
<td>dB</td>
<td></td>
<td></td>
<td>±(0.3+6% of atten setting)</td>
</tr>
<tr>
<td>VSWR</td>
<td>Full Attenuation Range</td>
<td>DC-2.5 GHz</td>
<td>Ratio</td>
<td>1.5:1</td>
<td></td>
<td>1.8:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DC-4.0 GHz</td>
<td>Ratio</td>
<td>1.8:1</td>
<td></td>
<td>2.0:1</td>
</tr>
<tr>
<td>Switching Speed</td>
<td>50% Cntl to 90%/10% RF</td>
<td>—</td>
<td>ns</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% to 90% or 90% to 10%</td>
<td>—</td>
<td>ns</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 dB Compression</td>
<td></td>
<td>50 MHz</td>
<td>dB</td>
<td></td>
<td>+21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5-4.0 GHz</td>
<td>dB</td>
<td></td>
<td>+27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input IP&lt;sub&gt;3&lt;/sub&gt;</td>
<td>Two-tone Inputs up to +5 dBm</td>
<td>50 MHz</td>
<td>dB</td>
<td></td>
<td>+35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5-4.0 GHz</td>
<td>dB</td>
<td></td>
<td>+48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+V&lt;sub&gt;CC&lt;/sub&gt;</td>
<td></td>
<td>—</td>
<td>V</td>
<td>4.75</td>
<td>5.0</td>
<td>5.25</td>
</tr>
<tr>
<td>-V&lt;sub&gt;EE&lt;/sub&gt;</td>
<td></td>
<td>—</td>
<td>V</td>
<td>-8.0</td>
<td>-5.0</td>
<td>-4.75</td>
</tr>
<tr>
<td>V&lt;sub&gt;L&lt;/sub&gt;</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>V&lt;sub&gt;H&lt;/sub&gt;</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>lin (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>I&lt;sub&gt;cc&lt;/sub&gt; (Quiescent</td>
<td>$V_{cntrl} = V_{CC}$ or GND</td>
<td>—</td>
<td>uA</td>
<td>250</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>Supply Current)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ΔI&lt;sub&gt;cc&lt;/sub&gt; (Additional</td>
<td>$V_{CC} = \text{Max, } V_{cntrl} = V_{CC} - 2.1\text{ V}$</td>
<td>—</td>
<td>mA</td>
<td></td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>Supply Current Per TTL Input Pin)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{EE}$ 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>
<td></td>
</tr>
<tr>
<td>Thermal Resistance $\theta_{jc}$</td>
<td></td>
<td>—</td>
<td>°C/W</td>
<td>15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Input Power</td>
<td>$+27\text{ dBm}$</td>
</tr>
<tr>
<td>0.05 GHz</td>
<td>$+34\text{ dBm}$</td>
</tr>
<tr>
<td>0.5-4.0 GHz</td>
<td></td>
</tr>
<tr>
<td>$V_{CC}$</td>
<td>$-0.5\text{V} \leq V_{CC} \leq +7.0\text{V}$</td>
</tr>
<tr>
<td>$V_{EE}$</td>
<td>$-8.5\text{V} \leq V_{EE} \leq +0.5\text{V}$</td>
</tr>
<tr>
<td>$V_{CC} - V_{EE}$</td>
<td>$-0.5\text{V} \leq V_{CC} - V_{EE} \leq +14.5\text{V}$</td>
</tr>
<tr>
<td>$Vin^5$</td>
<td>$-0.5\text{V} \leq Vin \leq V_{CC} + 0.5\text{V}$</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$-40^\circ \text{C to } +85^\circ \text{C}$</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$-65^\circ \text{C to } +125^\circ \text{C}$</td>
</tr>
</tbody>
</table>

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

**Recommended PCB Configuration**

6. Application Note S2083 is available online at www.macom.com

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

Moisture Sensitivity
The MSL rating for this part is defined as Level 2 per IPC/JEDEC J-STD-020. Parts shall be stored and/or baked as required for MSL Level 2 parts.

Typical Performance Curves

Reference Loss vs. Frequency

Attenuation - 1 dB Bit vs. Frequency

Attenuation - 2 dB Bit vs. Frequency

Attenuation - 4 dB Bit vs. Frequency

Truth Table (Digital Attenuator)

<table>
<thead>
<tr>
<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>Loss, Reference</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2.0 dB</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4.0 dB</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8.0 dB</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>15.0 dB</td>
</tr>
</tbody>
</table>

0 = TTL Low. 1 = TTL High
Typical Performance Curves

**Attenuation - 8 dB Bit vs. Frequency**

![Graph showing Attenuation - 8 dB Bit vs. Frequency with temperature variations at -40°C, 25°C, and 85°C](graph1.png)

**Attenuation - 15 dB Attenuation vs. Frequency**

![Graph showing Attenuation - 15 dB Attenuation vs. Frequency with temperature variations at -40°C, 25°C, and 85°C](graph2.png)

**VSWR vs. Frequency**

**Reference Loss State**

![Graph showing VSWR vs. Frequency with Reference Loss State at RF1 and RF2](graph3.png)

**VSWR - 1 dB Bit vs. Frequency**

![Graph showing VSWR - 1 dB Bit vs. Frequency with RF1 and RF2](graph4.png)

**VSWR - 2 dB Bit vs. Frequency**

![Graph showing VSWR - 2 dB Bit vs. Frequency with RF1 and RF2](graph5.png)

**VSWR - 4 dB Bit vs. Frequency**

![Graph showing VSWR - 4 dB Bit vs. Frequency with RF1 and RF2](graph6.png)

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Digital Attenuator
15.0 dB, 4-Bit, TTL Driver, DC-4.0 GHz

Typical Performance Curves

VSWR - 8 dB Bit vs. Frequency

VSWR - 15 dB Attenuation vs. Frequency

CSP-1, Lead-Free 4 x 6 mm, 32-lead PQFN†

† Reference Application Note M538 for lead-free solder reflow recommendations.
Digital Attenuator
15.0 dB, 4-Bit, TTL Driver, DC-4.0 GHz

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