Features

- Attenuation: 0.5 dB Steps to 31.5 dB
- Single Positive Supply
- Contains internal DC to DC converter
- Low DC Power Consumption
- Small Footprint, JEDEC Package
- Integral TTL Driver
- 50 ohm Impedance
- Lead-Free CSP-1 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free “Green” Mold Compound
- 260°C Reflow Compatible
- RoHS* Compliant Version of AT90-1107

Description

The MAATCC0011 is a GaAs FET 6-bit digital attenuator with integral TTL driver. Step size is 0.5 dB providing a 31.5 dB total attenuation range. This device is in a PQFN plastic surface mount package.

The MAATCC0011 is ideally suited for use where accuracy, fast speed, very low power consumption and low costs are required. For dual supply designs without switching noise, use MAATCC0009.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAATCC0011</td>
<td>Bulk Packaging</td>
</tr>
<tr>
<td>MAATCC0011TR</td>
<td>1000 piece reel</td>
</tr>
<tr>
<td>MAATCC0011-TB</td>
<td>Sample Test Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.


Schematic with Off-Chip Components
Digital Attenuator  
31.5 dB, 6-Bit, TTL Driver, DC - 4.0 GHz

Electrical Specifications:  Freq. = DC - 4 GHz, $T_A = +25^\circ$C

<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</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>4.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Attenuation Accuracy</td>
<td>Individual Bits 0.5-1-2-4-8-16 dB</td>
<td>dB</td>
<td>±(0.3 +7% of atten setting) ±(0.5 +8% of atten setting)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSWR</td>
<td>Full Range</td>
<td>Ratio</td>
<td>—</td>
<td>2.0:1</td>
<td>2.2:1</td>
</tr>
<tr>
<td>Switching Speed</td>
<td>50% Control to 90%/10% RF 10% to 90% or 90% to 10%</td>
<td>ns</td>
<td>75</td>
<td>20</td>
<td>—</td>
</tr>
<tr>
<td>1 dB Compression</td>
<td>50 MHz 0.5 - 4.0 GHz</td>
<td>dBm</td>
<td>21</td>
<td>24</td>
<td>—</td>
</tr>
<tr>
<td>Input IP3</td>
<td>Two-tone inputs up to +5 dBm 50 MHz 0.5 - 4.0 GHz</td>
<td>dB</td>
<td>35</td>
<td>48</td>
<td>—</td>
</tr>
<tr>
<td>$V_{CC}$</td>
<td>—</td>
<td>V</td>
<td>4.75</td>
<td>5.0</td>
<td>5.25</td>
</tr>
<tr>
<td>$V_{IL}$</td>
<td>LOW-level input voltage</td>
<td>V</td>
<td>0.0</td>
<td>2.0</td>
<td>—</td>
</tr>
<tr>
<td>$V_{IH}$</td>
<td>HIGH-level input voltage</td>
<td>V</td>
<td>—</td>
<td>—</td>
<td>5.0</td>
</tr>
<tr>
<td>Input Leakage Current</td>
<td>$V_{IN} = V_{CC}$ or GND</td>
<td>$\mu$A</td>
<td>-1.0</td>
<td>—</td>
<td>1.0</td>
</tr>
<tr>
<td>$I_{CC}$</td>
<td>$V_{CC}$ min to max, Logic “0” or “1”</td>
<td>mA</td>
<td>—</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Turn-on Current$^6$</td>
<td>For guaranteed start-up</td>
<td>mA</td>
<td>—</td>
<td>—</td>
<td>125</td>
</tr>
<tr>
<td>$\Delta I_{CC}$ (Additional Supply Current Per TTL Input Pin)</td>
<td>$V_{CC} = \text{max, } V_{CNTRL} = V_{CC} - 2.1 \text{ V}$</td>
<td>mA</td>
<td>—</td>
<td>—</td>
<td>1.0</td>
</tr>
<tr>
<td>Switching Noise</td>
<td>Generated from DC-DC Converter with recommended capacitors @ 3.5 MHz</td>
<td>dBm</td>
<td>—</td>
<td>-93</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>$^\circ$C/W</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
</tbody>
</table>

5. During turn-on, the device requires an initial “Turn-on Current”. Once operational, $I_{CC}$ will drop to the specified levels.
6. The DC-DC converter is guaranteed to start in 100 $\mu$s as long as the power supplies can provide a minimum of 100 mA “Turn-on Current”.

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Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>- 0.05 GHz +27 dBm 0.5 - 2.0 GHz +34 dBm</td>
</tr>
<tr>
<td>V_CC</td>
<td>-0.5 V ≤ V_CC ≤ +6.0 V</td>
</tr>
<tr>
<td>V_IN</td>
<td>-0.5 V ≤ V_IN ≤ V_CC + 0.5 V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40ºC to +85ºC</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65ºC to +125ºC</td>
</tr>
</tbody>
</table>

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

Truth Table (Digital Attenuator)

<table>
<thead>
<tr>
<th>C16</th>
<th>C8</th>
<th>C4</th>
<th>C2</th>
<th>C1</th>
<th>C0.</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>0.5 dB</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.0 dB</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</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>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>1</td>
<td>1</td>
<td>16.0 dB</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>31.5 dB</td>
</tr>
</tbody>
</table>

0 = TTL Low; 1 = TTL High

Recommended PCB Configuration

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

**Insertion Loss**

![Insertion Loss Graph](image1.png)

**VSWR @ Insertion Loss**

![VSWR Graph](image2.png)

**Attenuation Error, 0.5 dB Bit**

![Attenuation Error 0.5 dB Graph](image3.png)

**Attenuation Error, 1 dB Bit**

![Attenuation Error 1 dB Graph](image4.png)

**Attenuation Error, 2 dB Bit**

![Attenuation Error 2 dB Graph](image5.png)

**Attenuation Error, 4 dB Bit**

![Attenuation Error 4 dB Graph](image6.png)
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Typical Performance Curves

**Attenuation Error, 8 dB Bit**

![Graph showing Attenuation Error, 8 dB Bit](image1)

**Attenuation Error, 16 dB Bit**

![Graph showing Attenuation Error, 16 dB Bit](image2)

**Attenuation Error, Max. Attenuation**

![Graph showing Attenuation Error, Max. Attenuation](image3)

**VSWR, 0.5 dB Bit**

![Graph showing VSWR, 0.5 dB Bit](image4)

**VSWR, 1 dB Bit**

![Graph showing VSWR, 1 dB Bit](image5)

**VSWR, 2 dB Bit**

![Graph showing VSWR, 2 dB Bit](image6)

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Typical Performance Curves

**VSWR, 4 dB Bit**

![Graph showing VSWR for 4 dB Bit]

**VSWR, 8 dB Bit**

![Graph showing VSWR for 8 dB Bit]

**VSWR, 16 dB Bit**

![Graph showing VSWR for 16 dB Bit]

**VSWR, Max. Attenuation**

![Graph showing VSWR for Max. Attenuation]
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Typical Performance Curves

Typical Attenuation Deviation vs. Temperature for 0.5 dB Bit

Typical Attenuation Deviation vs. Temperature for 1 dB Bit

Typical Attenuation Deviation vs. Temperature for 2 dB Bit

Typical Attenuation Deviation vs. Temperature for 4 dB Bit

Typical Attenuation Deviation vs. Temperature for 8 dB Bit

Typical Attenuation Deviation vs. Temperature for 16 dB Bit
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Typical Performance Curves

**Typical Attenuation Deviation vs. Temperature at Maximum Attenuation**

**Insertion Loss vs. Temperature**

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

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