Digital Attenuator
31.5 dB, 6-Bit, TTL Driver, DC - 4.0 GHz

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.

## 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>4.5</td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>Attenuation Accuracy</td>
<td>Individual Bits 0.5-1-2-4-8-16 dB Any Combination of Bits 1 to 31.5 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>2.0:1</td>
<td>2.2:1</td>
<td></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>$V_{IL}$ $V_{IH}$</td>
<td>LOW-level input voltage HIGH-level input voltage</td>
<td>V</td>
<td>0.0</td>
<td>2.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Input Leakage Current $V_{IN} = V_{CC}$ or GND</td>
<td></td>
<td>µA</td>
<td>-1.0</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>$I_{CC}$ $^5$</td>
<td>$V_{CC}$ min to max, Logic &quot;0&quot; or &quot;1&quot;</td>
<td>mA</td>
<td>6</td>
<td>10</td>
<td></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>$V_{CC} = max, V_{CNTRL} = V_{CC} - 2.1 V$</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>-93</td>
<td></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>°C/W</td>
<td>15</td>
<td></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 µs as long as the power supplies can provide a minimum of 100 mA “Turn-on Current".
Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power 0.05 GHz</td>
<td>+27 dBm</td>
</tr>
<tr>
<td>0.5 - 2.0 GHz</td>
<td>+34 dBm</td>
</tr>
<tr>
<td>$V_{CC}$</td>
<td>$-0.5 \leq V_{CC} \leq +6.0$ V</td>
</tr>
<tr>
<td>$V_{IN}$</td>
<td>$-0.5 \leq V_{IN} \leq V_{CC} + 0.5$ V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$-40^\circ C$ to $+85^\circ C$</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$-65^\circ C$ to $+125^\circ C$</td>
</tr>
</tbody>
</table>

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>0</td>
<td>1</td>
<td>0</td>
<td>1.0 dB</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2.0 dB</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.0 dB</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8.0 dB</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</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**

**VSWR @ Insertion Loss**

**Attenuation Error, 0.5 dB Bit**

**Attenuation Error, 1 dB Bit**

**Attenuation Error, 2 dB Bit**

**Attenuation Error, 4 dB Bit**

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Typical Performance Curves

**Attenuation Error, 8 dB Bit**

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

**Attenuation Error, 16 dB Bit**

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

**Attenuation Error, Max. Attenuation**

![Max. Attenuation Error Graph](image3)

**VSWR, 0.5 dB Bit**

![0.5 dB Bit VSWR Graph](image4)

**VSWR, 1 dB Bit**

![1 dB Bit VSWR Graph](image5)

**VSWR, 2 dB Bit**

![2 dB Bit VSWR Graph](image6)
Typical Performance Curves

**VSWR, 4 dB Bit**

![VSWR, 4 dB Bit Graph]

**VSWR, 8 dB Bit**

![VSWR, 8 dB Bit Graph]

**VSWR, 16 dB Bit**

![VSWR, 16 dB Bit Graph]

**VSWR, Max. Attenuation**

![VSWR, Max. Attenuation Graph]
Typical Performance Curves

**Typical Attenuation Deviation vs. Temperature for 0.5 dB Bit**

![Graph showing typical attenuation deviation vs. temperature for 0.5 dB bit over frequency range from 0 to 4000 MHz]

**Typical Attenuation Deviation vs. Temperature for 1 dB Bit**

![Graph showing typical attenuation deviation vs. temperature for 1 dB bit over frequency range from 0 to 4000 MHz]

**Typical Attenuation Deviation vs. Temperature for 2 dB Bit**

![Graph showing typical attenuation deviation vs. temperature for 2 dB bit over frequency range from 0 to 4000 MHz]

**Typical Attenuation Deviation vs. Temperature for 4 dB Bit**

![Graph showing typical attenuation deviation vs. temperature for 4 dB bit over frequency range from 0 to 4000 MHz]

**Typical Attenuation Deviation vs. Temperature for 8 dB Bit**

![Graph showing typical attenuation deviation vs. temperature for 8 dB bit over frequency range from 0 to 4000 MHz]

**Typical Attenuation Deviation vs. Temperature for 16 dB Bit**

![Graph showing typical attenuation deviation vs. temperature for 16 dB bit over frequency range from 0 to 4000 MHz]
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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.
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