MAAD-007080

Digital Attenuator
50.0 dB, 6-Bit, TTL Driver, DC-2.4 GHz

Features
- Attenuation: 1 dB Steps to 50 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 AT90-1106

Description
The MAAD-007080 is a GaAs FET 6-bit digital attenuator with integral TTL driver. Step size is 1 dB providing a 50 dB total attenuation range. This device is in a PQFN plastic surface mount package. MAAD-007080 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 MAAD-007082-000100.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAD-007080-00100</td>
<td>Bulk Packaging</td>
</tr>
<tr>
<td>MAAD-007080-001TR</td>
<td>1000 piece reel</td>
</tr>
<tr>
<td>MAAD-0007080-001TB</td>
<td>Sample Test Board</td>
</tr>
</tbody>
</table>

Pin Configuration

- The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)
- Pins 10 & 29 must be isolated
- -Vee is produced internally and requires a .1µF cap to GND.
- Generated noise is typical of switching DC-DC Converters.

### Digital Attenuator

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**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 - 2.4 GHz</td>
<td>dB</td>
<td>5.5</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>Attenuation Accuracy</td>
<td>Individual Bits 1-2-4-8-16-32 dB</td>
<td>DC - 2.4 GHz</td>
<td>dB</td>
<td>±(3 +5% of atten setting)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any Combination of Bits 1 to 50 dB</td>
<td>DC - 2.4 GHz</td>
<td>dB</td>
<td>±(5 +8% of atten setting)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSWR</td>
<td>Full Range</td>
<td>DC - 2.4 GHz</td>
<td>Ratio</td>
<td>1.8:1</td>
<td>2:1</td>
<td></td>
</tr>
<tr>
<td>Switching Speed</td>
<td>50% Cntl to 90%/10% RF 10% to 90% or 90% to 10%</td>
<td>--</td>
<td>ns</td>
<td>75</td>
<td>20</td>
<td>--</td>
</tr>
<tr>
<td>1 dB Compression</td>
<td>50 MHz 0.5 - 2.4 GHz dBm</td>
<td>--</td>
<td>--</td>
<td>+21</td>
<td>+24</td>
<td>--</td>
</tr>
<tr>
<td>Input IP$_2$</td>
<td>Two-tone inputs up to +5 dBm</td>
<td>50 MHz 0.5-2.4 GHz dBm</td>
<td>--</td>
<td>+35</td>
<td>+48</td>
<td>--</td>
</tr>
<tr>
<td>Vcc</td>
<td>--</td>
<td>-- V</td>
<td></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></td>
<td>0.0</td>
<td>2.0</td>
<td>0.8</td>
</tr>
<tr>
<td>$V_{ih}$</td>
<td>HIGH-level input voltage</td>
<td>-- V</td>
<td></td>
<td></td>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td>$I_{in}$ (Input Leakage Current)</td>
<td>$V_{in} = V_{cc}$ or GND</td>
<td>-- µA</td>
<td></td>
<td>-1.0</td>
<td>--</td>
<td>1.0</td>
</tr>
<tr>
<td>$I_{cc}^4$</td>
<td>Vcc min to max, Logic &quot;0&quot; or &quot;1&quot;</td>
<td>-- mA</td>
<td></td>
<td>6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Turn-on Current $^5$</td>
<td>For guaranteed start-up</td>
<td>-- mA</td>
<td></td>
<td>125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta I_{cc}$ (Additional Supply Current Per TTL Input Pin)</td>
<td>$V_{cc} = Max$, $V_{ctrl} = V_{cc} - 2.1\ V$</td>
<td>mA</td>
<td>--</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switching Noise</td>
<td>Generated from DC-DC Converter with recommended capacitors</td>
<td>3.5 MHz dBm</td>
<td>--</td>
<td>-93</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Thermal Resistance $\theta_{jc}$</td>
<td></td>
<td>-- °C/W</td>
<td></td>
<td>15</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

4. During turn-on, the device requires an initial “Turn-on Current”. Once operational, $I_{cc}$ will drop to the specified levels.

5. 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 $^6,^7$

<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 - 2.4 GHz</td>
<td>+34 dBm</td>
</tr>
<tr>
<td>$V_{cc}$</td>
<td>-0.5 V $\leq V_{cc} \leq +6.0 V$</td>
</tr>
<tr>
<td>$V_{in}^8$</td>
<td>-0.5 V $\leq V_{in} \leq V_{cc} + 0.5 V$</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>

6. Exceeding any one or combination of these limits may cause permanent damage to this device.

7. MACOM does not recommend sustained operation near these survivability limits.

8. Standard CMOS TTL interface, latch-up will occur if logic signal is applied prior to power supply.

### Recommended PCB Configuration $^9$

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, 1 dB Bit

Attenuation Error, 2 dB Bit
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Typical Performance Curves

**Attenuation Error, 4 dB Bit**

```
Frequency (MHz)
```

```
Attenuation Error (dB)
```

**Attenuation Error, 8 dB Bit**

```
Frequency (MHz)
```

```
Attenuation Error (dB)
```

**Attenuation Error, 16 dB Bit**

```
Frequency (MHz)
```

```
Attenuation Error (dB)
```

**Attenuation Error, 32 dB Bit**

```
Frequency (MHz)
```

```
Attenuation Error (dB)
```

**VSWR, 1 dB Bit**

```
Frequency (MHz)
```

```
VSWR
```

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

**VSWR, 2 dB Bit**

**VSWR, 4 dB Bit**

**VSWR, 8 dB Bit**

**VSWR, 16 dB Bit**

**VSWR, 32 dB Bit**

**VSWR, Maximum attenuation**

Visit [www.macom.com](http://www.macom.com) for additional data sheets and product information.

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Typical Performance Curves

Maximum IP3 over Temperature Range and Attenuation @ 50 MHz

![Graph showing Maximum IP3 over Temperature Range and Attenuation @ 50 MHz]

Maximum IP3 over Temperature Range and Attenuation @ 950 MHz

![Graph showing Maximum IP3 over Temperature Range and Attenuation @ 950 MHz]

Maximum IP3 over Temperature Range and Attenuation @ 1900 MHz

![Graph showing Maximum IP3 over Temperature Range and Attenuation @ 1900 MHz]
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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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