Features

- Attenuation: 2 dB Steps to 30 dB
- Single Positive Supply
- Contains Internal DC to DC Converter
- 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 AT90-1233

Description

M/A-COM’s MAAD-007079-000100 is a GaAs FET 4-Bit digital attenuator with integral driver. Step size is 2 dB providing a 30 dB attenuation range. This device is in an FQFP-N plastic surface mount package. The MAAD-007079-000100 is suited for single supply applications where accuracy, fast speed, low power consumption and low costs are required. For dual supply designs without switching noise, use MAATCC0012.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAD-007079-000100</td>
<td>Bulk Packaging</td>
</tr>
<tr>
<td>MAAD-007079-0001TR</td>
<td>1000 piece reel</td>
</tr>
<tr>
<td>MAAD-007079-0001TB</td>
<td>Sample Test Board</td>
</tr>
</tbody>
</table>

Note: Reference Application Note M513 for reel size information.


1. Pins 10 and 29 must be isolated.
2. VEE is produced internally and requires a .1 µF cap to GND. Generated noise is typical of switching DC-DC Converters.
3. The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)
Digital Attenuator
30.0 dB, 4-Bit, TTL Driver, DC-2.5 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 - 2.5 GHz</td>
<td>dB</td>
<td>—</td>
<td>—</td>
<td>2.7</td>
</tr>
<tr>
<td>Attenuation Accuracy</td>
<td>Individual Bits or Combination of Bits</td>
<td>DC - 2.5 GHz</td>
<td>dB</td>
<td>—</td>
<td>—</td>
<td>±(0.3 +5% of atten setting)</td>
</tr>
<tr>
<td>VSWR</td>
<td>Full Range</td>
<td>DC - 2.5 GHz</td>
<td>Ratio</td>
<td>—</td>
<td>1.5:1</td>
<td>1.8:1</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>—</td>
<td>75</td>
<td>150</td>
</tr>
<tr>
<td>1 dB Compression</td>
<td>—</td>
<td>50 MHz</td>
<td>dBm</td>
<td>—</td>
<td>+21</td>
<td>—</td>
</tr>
<tr>
<td>Input IP$_3$</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></td>
<td>0.5 - 2.5 GHz</td>
<td>dB</td>
<td>—</td>
<td>+48</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>$V_L$</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>$V_H$</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 = Vcc or GND</td>
<td>—</td>
<td>uA</td>
<td>-1.0</td>
<td>—</td>
<td>1.0</td>
</tr>
<tr>
<td>$I_{cc}^4$</td>
<td>Vcc min to max, Logic “0” or “1”</td>
<td>—</td>
<td>mA</td>
<td>—</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Turn-on Current$^5$</td>
<td>For guaranteed start-up</td>
<td>—</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>$V_{CC} = \text{Max}, V_{ctrl} = V_{CC} - 2.1 V$</td>
<td>—</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</td>
<td>3.5 MHz</td>
<td>dBm</td>
<td>—</td>
<td>-93</td>
<td>—</td>
</tr>
<tr>
<td>Thermal Resistance $\theta_{jc}$</td>
<td>—</td>
<td>—</td>
<td>°C/W</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
</tbody>
</table>

4. During turn-on, the device requires an initial start up current ($I_{cc}$) specified as “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 have the maximum turn-on current available for start-up.

Absolute Maximum Ratings $^6$, $^7$

<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>0.05 GHz</td>
<td>$+34$ dBm</td>
</tr>
<tr>
<td>0.5 - 2.5 GHz</td>
<td>$-0.5V \leq V_{CC} \leq +6.0V$</td>
</tr>
<tr>
<td>$V_{IN}^8$</td>
<td>$-0.5V \leq V_{IN} \leq V_{CC} + 0.5V$</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>$-40^\circ C \text{ to } +85^\circ C$</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$-65^\circ C \text{ to } +125^\circ C$</td>
</tr>
</tbody>
</table>

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. M/A-COM 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 $^9$

9. Application Note C2083 is available on line at www.macom.com

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.

Truth Table (Digital Attenuator)

<table>
<thead>
<tr>
<th>C16</th>
<th>C6</th>
<th>C4</th>
<th>C2</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>2.0 dB</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4.0 dB</td>
</tr>
<tr>
<td>0</td>
<td>1</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>16.0 dB</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>30.0 dB</td>
</tr>
</tbody>
</table>

0 = TTL Low; 1 = TTL High

Typical Performance Curves

Insertion Loss

VSWR @ Insertion Loss

Attenuation Error, 2 dB Bit

Attenuation Error, 4 dB Bit
Digital Attenuator
30.0 dB, 4-Bit, TTL Driver, DC-2.5 GHz

Typical Performance Curves

**Attenuation Error, 8 dB Bit**

```
Frequency (MHz) | Attenuation (dB)
---|---
0 | -0.40
500 | -0.20
1000 | 0.00
1500 | 0.20
2000 | 0.40
2500 | 0.00
```

**Attenuation Error, 16 dB Bit**

```
Frequency (MHz) | Attenuation (dB)
---|---
0 | -0.20
500 | -0.40
1000 | -0.60
1500 | -0.80
2000 | -0.50
2500 | -0.20
```

**Attenuation Error, Max. Attenuation**

```
Frequency (MHz) | Attenuation (dB)
---|---
0 | -1.50
500 | -1.00
1000 | -0.50
1500 | 0.00
2000 | 0.50
2500 | 1.00
```

**VSWR, 2 dB Bit**

```
Frequency (MHz) | VSWR
---|---
0 | 1.00
500 | 1.20
1000 | 1.40
1500 | 1.60
2000 | 0.00
2500 | 0.50
```

**VSWR, 4 dB Bit**

```
Frequency (MHz) | VSWR
---|---
0 | 1.20
500 | 1.40
1000 | 1.60
1500 | 0.00
2000 | 0.50
2500 | 1.00
```

**VSWR, 8 dB Bit**

```
Frequency (MHz) | VSWR
---|---
0 | 1.40
500 | 1.60
1000 | 0.00
1500 | 0.50
2000 | 1.00
2500 | 1.50
```
Digital Attenuator
30.0 dB, 4-Bit, TTL Driver, DC-2.5 GHz

Typical Performance Curves

VSWR, 16 dB Bit

VSWR, Maximum Attenuation

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

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