Features

- Attenuation: 2 dB Steps to 30 dB
- Temperature Stability: ± 0.18 dB from –55°C to +85°C Typical
- Low DC Power Consumption
- Hermetic Surface Mount Package
- Integral TTL Driver
- 50 Ohm Nominal Impedance
- Lead-Free CR-12 Package
- 260°C Reflow Compatible
- RoHS* Compliant

Description

M/A-COM’s AT-233-PIN is a GaAs FET 4-Bit digital attenuator with a 2 dB minimum step size and 30 dB total attenuation. This attenuator and integral TTL driver is in a hermetically sealed ceramic 16-lead surface mount package. The AT-233-PIN is ideally suited for use where accuracy, fast switching, very low power consumption and low intermodulation products are required. Typical applications include dynamic range setting in precision receiver circuits and other gain/leveling control circuits. Environmental screening is available. Contact the factory for information.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT-233-PIN</td>
<td>Bulk Packaging</td>
</tr>
<tr>
<td>MAAD-007228-0001TR</td>
<td>1000 piece reel</td>
</tr>
<tr>
<td>MAAD-007228-0001TB</td>
<td>Sample Test Board</td>
</tr>
</tbody>
</table>

Note: Reference Application Note M513 for reel size information.

Digital Attenuator
30.0 dB, 4-Bit, TTL Driver, DC-2.0 GHz

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>Reference Insertion Loss</td>
<td></td>
<td>DC - 0.5 GHz</td>
<td>dB</td>
<td>—</td>
<td>—</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DC - 1.0 GHz</td>
<td>dB</td>
<td>—</td>
<td>—</td>
<td>2.65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DC - 2.0 GHz</td>
<td>dB</td>
<td>—</td>
<td>—</td>
<td>2.8</td>
</tr>
<tr>
<td>Attenuation Accuracy$^2$</td>
<td>Any Single Bit</td>
<td>DC - 1.0 GHz</td>
<td>dB</td>
<td>± (0.2 + 3% of attenuation setting in dB) dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DC - 2.0 GHz</td>
<td>dB</td>
<td>± (0.2 + 3% of attenuation setting in dB) dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any Combination of Bits</td>
<td>DC - 1.0 GHz</td>
<td>dB</td>
<td>± (0.20 + 3% of attenuation setting in dB) dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DC - 2.0 GHz</td>
<td>dB</td>
<td>± (0.25 + 4% of attenuation setting in dB) dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSWR</td>
<td></td>
<td>DC - 2.0 GHz</td>
<td>Ratio</td>
<td>—</td>
<td>—</td>
<td>1.7:1</td>
</tr>
<tr>
<td>Trise, Tfall</td>
<td>10% to 90%</td>
<td>—</td>
<td>ns</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>Ton, Toff</td>
<td>50% Control to 90/10% RF</td>
<td>—</td>
<td>ns</td>
<td>—</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td>Transients</td>
<td>In-Band (peak-peak)</td>
<td>—</td>
<td>mV</td>
<td>—</td>
<td>35</td>
<td>—</td>
</tr>
<tr>
<td>1 dB Compression$^3$</td>
<td>Input Power</td>
<td>0.05 GHz</td>
<td>dBm</td>
<td>—</td>
<td>+20</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5 - 2.0 GHz</td>
<td>dBm</td>
<td>—</td>
<td>+28</td>
<td>—</td>
</tr>
<tr>
<td>Input IP3$^3$</td>
<td>For two tone input power</td>
<td>0.05 GHz</td>
<td>dBm</td>
<td>—</td>
<td>+40</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5 - 2.0 GHz</td>
<td>dBm</td>
<td>—</td>
<td>+50</td>
<td>—</td>
</tr>
<tr>
<td>Input IP2$^3$</td>
<td>For two-tone input power</td>
<td>0.05 GHz</td>
<td>dBm</td>
<td>—</td>
<td>+45</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5 - 2.0 GHz</td>
<td>dBm</td>
<td>—</td>
<td>+68</td>
<td>—</td>
</tr>
<tr>
<td>V$^\text{CC}$</td>
<td></td>
<td>—</td>
<td>V</td>
<td>4.5</td>
<td>5.0</td>
<td>5.5</td>
</tr>
<tr>
<td>V$^\text{EE}$</td>
<td></td>
<td>—</td>
<td>V</td>
<td>-8.0</td>
<td>—</td>
<td>-5.0</td>
</tr>
<tr>
<td>I$^\text{CC}$</td>
<td>$V_{\text{CC}} = 4.5$ to 5.5 V</td>
<td>—</td>
<td>mA</td>
<td>—</td>
<td>—</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>$V_{\text{ctl}} = 0$ to 0.8V, or $V_{\text{CC}} - 2.1$ V to $V_{\text{CC}}$</td>
<td>—</td>
<td>mA</td>
<td>—</td>
<td>—</td>
<td>4.0</td>
</tr>
<tr>
<td>I$^\text{EE}$</td>
<td>$V_{\text{EE}} = -5.0$ to -8.0 V</td>
<td>—</td>
<td>mA</td>
<td>—</td>
<td>—</td>
<td>1.0</td>
</tr>
<tr>
<td>V$^\text{ctl}$</td>
<td>Logic 0 (TTL)</td>
<td>—</td>
<td>V</td>
<td>0.0</td>
<td>—</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>Logic 1 (TTL)</td>
<td>—</td>
<td>V</td>
<td>2.0</td>
<td>—</td>
<td>5.0</td>
</tr>
<tr>
<td>Input Leakage Current (Low)</td>
<td>0 to 0.8V</td>
<td>—</td>
<td>µA</td>
<td>—</td>
<td>—</td>
<td>1.0</td>
</tr>
<tr>
<td>Input Leakage Current (High)</td>
<td>2.0 to 5.0V</td>
<td>—</td>
<td>µA</td>
<td>—</td>
<td>—</td>
<td>1.0</td>
</tr>
</tbody>
</table>

1. All specifications apply when operated with bias voltages of +5V for $V_{\text{CC}}$ and -5.0V to -8.0V for $V_{\text{EE}}$, and 50 Ohm impedance at all ports unless otherwise specified.
2. This attenuator is guaranteed monotonic.
3. $V_{\text{EE}} = -5$V for the typical numbers given.
AT-233-PIN

Digital Attenuator
30.0 dB, 4-Bit, TTL Driver, DC-2.0 GHz

Absolute Maximum Ratings 4,5

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Input Power</td>
<td></td>
</tr>
<tr>
<td>0.5 GHz</td>
<td>+27 dBm</td>
</tr>
<tr>
<td>0.5 - 2.0 GHz</td>
<td>+34 dBm</td>
</tr>
<tr>
<td>VCC</td>
<td>-0.5V ≤ VCC ≤ +7.0V</td>
</tr>
<tr>
<td>VEE</td>
<td>-8.5V ≤ VEE ≤ +0.5V</td>
</tr>
<tr>
<td>VCC - VEE</td>
<td>-0.5V ≤ VCC - VEE ≤ +14.5V</td>
</tr>
<tr>
<td>Vin8</td>
<td>-0.5V ≤ Vin ≤ VCC + 0.5V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-55°C to +125°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

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

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.

Typical Performance Curves

Ref. Insertion Loss vs. Frequency

VSWR vs. Frequency

Recommended PCB Configuration

Truth Table (Digital Attenuator)

<table>
<thead>
<tr>
<th>C4</th>
<th>C3</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>Reference</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2 dB</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4 dB</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>8 dB</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16 dB</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>30 dB</td>
</tr>
</tbody>
</table>

0 = TTL Low; 1 = TTL High
Digital Attenuator
30.0 dB, 4-Bit, TTL Driver, DC-2.0 GHz

Typical Performance Curves

Attenuation Accuracy vs. Frequency

Lead-Free CR-12 Ceramic Package†

Visits www.macom.com for additional data sheets and product information.

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

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