MA4P7455-1225

Quad PIN Diode π Attenuator
10 - 4000 MHz

Features
- 4 PIN diodes in a SOT-25 Plastic Package
- Externally Selectable Bias and RF Matching Network
- 10 – 4,000 MHz Useable Frequency Band
- +43 dBm IP3 @ 1000 MHz (50 Ω)
- 1.0 dB Loss @ 1000 MHz (50 Ω)
- 30 dB Attenuation @ 1000 MHz (50 Ω)
- Lead-Free SOT-25 Package
- 100% Matte Tin Plating over Copper
- Halogen-Free "Green" Mold Compound
- 260°C Reflow Compatible
- RoHS* Compliant Version of MA4P274-1225

Description
M/A-COM’s MA4P7455-1225 is a wideband, lower insertion loss, high IP3, Quad PIN diode π attenuator in a low-cost, lead free surface mount SOT-25 package. Four PIN diodes in one package reduce design parasitics and improve circuit density.

These PIN diode attenuators perform well where RF signal amplitude control is required in 50 Ω handset circuits and 75 Ω broadband CATV systems. Exceptional insertion loss, attenuation range, and IP3 at <10 mA bias make these devices suitable for better power level control in RF amplifiers.

Ordering Information1

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA4P7455-1225T</td>
<td>Tape and Reel</td>
</tr>
<tr>
<td>MADP-007455-001SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

Functional Schematic

Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RF IN</td>
<td>4</td>
<td>Shunt 1 Bias</td>
</tr>
<tr>
<td>2</td>
<td>Series Bias</td>
<td>5</td>
<td>Shunt 2 Bias</td>
</tr>
<tr>
<td>3</td>
<td>RF OUT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Absolute Maximum Ratings2,3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature</td>
<td>-65 °C to +125 °C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65 °C to +150 °C</td>
</tr>
<tr>
<td>No Dissipated Power</td>
<td></td>
</tr>
<tr>
<td>DC Voltage at Temperature Extremes</td>
<td>- 100 V</td>
</tr>
<tr>
<td>DC Current</td>
<td>75 mA</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.

2. Exceeding any one or combination of these limits may cause permanent damage to this device.
3. M/A-COM does not recommend sustained operation near these survivability limits.


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### Typical 50 Ω Performance\(^4\) @ 25°C using Wideband RF Circuit Design

<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>+3 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dB</td>
<td>—</td>
<td>-2.0</td>
<td>—</td>
</tr>
<tr>
<td>Insertion Loss</td>
<td>+6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dB</td>
<td>—</td>
<td>-1.0</td>
<td>—</td>
</tr>
<tr>
<td>Return Loss</td>
<td>+6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dB</td>
<td>—</td>
<td>-10</td>
<td>—</td>
</tr>
<tr>
<td>Attenuation</td>
<td>0 mA - Series Diode Bias / 0.75 V - Shunt 1 and 2 Bias 1000 MHz</td>
<td>dB</td>
<td>—</td>
<td>-29</td>
<td>—</td>
</tr>
<tr>
<td>Input IP3</td>
<td>0 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dBm</td>
<td>—</td>
<td>43</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>+6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dBm</td>
<td>—</td>
<td>43</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>F1 = 1000 MHz, F2 = 1100 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input IP3</td>
<td>0 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dBm</td>
<td>—</td>
<td>43</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>+6.5 mA Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dBm</td>
<td>—</td>
<td>33</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>F1 = 100 MHz, F2 = 110 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Settling Time</td>
<td>Within 1 dB of Final Attenuation Value 1000 MHz</td>
<td>µS</td>
<td>—</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>RF C.W. Incident</td>
<td>0 - 20 V Series Diode Bias / 0.75 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dBm</td>
<td>—</td>
<td>+20</td>
<td>—</td>
</tr>
</tbody>
</table>

\(^4\) Values shown include through loss calibrated out of RF test circuit.

### Typical 75 Ω Performance\(^5\) @ +25°C using Wideband RF Circuit Design

<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>+2 mA Series Diode Bias / 1.0 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dB</td>
<td>—</td>
<td>-1.1</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>+4.5 mA Series Diode Bias / 1.0 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dB</td>
<td>—</td>
<td>-0.6</td>
<td>—</td>
</tr>
<tr>
<td>Attenuation</td>
<td>0 mA / Series Diode and 1.0 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dB</td>
<td>—</td>
<td>-27</td>
<td>—</td>
</tr>
<tr>
<td>Return Loss</td>
<td>+4.5 mA / Series Diode and 1.0 V Shunt 1 and 2 Bias 1000 MHz</td>
<td>dB</td>
<td>—</td>
<td>-10</td>
<td>—</td>
</tr>
</tbody>
</table>

\(^5\) Values shown include through loss calibrated out of RF test circuit.
Quad PIN Diode π Attenuator
10 - 4000 MHz

Recommended PCB Layout

Parts List

<table>
<thead>
<tr>
<th>Part</th>
<th>Value</th>
<th>Case Style</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C2, C3, C4, C5</td>
<td>100 pF</td>
<td>0603</td>
<td>Murata</td>
</tr>
<tr>
<td>R1, R2, R3, R4, R5</td>
<td>1000 Ω</td>
<td>0402</td>
<td>Panasonic</td>
</tr>
</tbody>
</table>

MA4P7455-1225T Spice Model

Pin Diode Model
NLPINM2
Is = 1E-14 A
Vi = 0 V
Un = 900 cm²/V-sec
Wi = 60 um
Rr = 1.25 Ohm
Cmin = 0.20 pF
Tau = 1.0 usec
Rs = 0.1 Ohm
Cjo = 0.27 pF
Vj = 0.7 V
M = 0.5
Fc = 0.5
Imax = 2.5E+6 A/m²
Kf = 0
Af = 1

Series and Shunt Diode Bias Currents as a Function of Vseries and Vshunt Voltage
(Values shown are PER DIODE)

<table>
<thead>
<tr>
<th>Vshunt Bias (V)</th>
<th>Vseries Bias (V)</th>
<th>Iseries Diode (mA)</th>
<th>Ishunt Diode (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75</td>
<td>0</td>
<td>0.000</td>
<td>0.192</td>
</tr>
<tr>
<td>0.75</td>
<td>1</td>
<td>0.106</td>
<td>0.120</td>
</tr>
<tr>
<td>0.75</td>
<td>2</td>
<td>0.443</td>
<td>0.048</td>
</tr>
<tr>
<td>0.75</td>
<td>3</td>
<td>0/773</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>4</td>
<td>1.099</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>5</td>
<td>1.426</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>6</td>
<td>1.750</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>7</td>
<td>2.092</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>8</td>
<td>2.424</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>9</td>
<td>2.756</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>10</td>
<td>3.088</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>11</td>
<td>3.421</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>12</td>
<td>3.754</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>13</td>
<td>4.087</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>14</td>
<td>4.410</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>15</td>
<td>4.743</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>16</td>
<td>5.081</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>17</td>
<td>5.406</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>18</td>
<td>5.750</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>19</td>
<td>6.079</td>
<td>0</td>
</tr>
<tr>
<td>0.75</td>
<td>20</td>
<td>6.413</td>
<td>0</td>
</tr>
</tbody>
</table>
Schematic 10 - 1000 MHz, 50 Ω, RF Circuit

9. Keeping PIN 4 & PIN 5 as Separate Bias Points (Same V) reduces RF leakage (increases attenuation) through an otherwise connected Common Anode Bias Note.

Schematic 1 - 4 GHz, 50 Ω, RF Circuit

10. Keeping PIN 4 & PIN 5 as Separate Bias Points (Same V) reduces RF leakage through an otherwise connected Common Anode Bias Node.
MA4P7455-1225

Quad PIN Diode π Attenuator
10 - 4000 MHz

M/A-COM Products
Rev. V2

Lumped Element Model for MA4P7455-1225 PIN Diode π Attenuator in SOT-25

Lead Free SOT-25 †

† Reference Application Note M538 for lead-free solder reflow recommendations. Meets JEDEC moisture sensitivity level 1 requirements.
MA4P7455-1225

Quad PIN Diode π Attenuator
10 - 4000 MHz

Typical Performance Curves @ +25°C, 50 - 1000 MHz, Shunt Bias = 0.75 Volts

**Insertion Loss vs. Frequency**

-2.5 to -0.5 dB

Frequency (MHz) 0 200 400 600 800 1000

**Attenuation vs. Control Voltage**

-70 to 0 dB

Control Voltage (V) 0 5 10 15 20

**Input Return Loss vs. Control Voltage**

-40 to 0 dB

Control Voltage (V) 0 5 10 15 20

**Output Return Loss vs. Control Voltage**

-40 to 0 dB

Control Voltage (V) 0 5 10 15 20

**IP3 vs. Control Voltage**

-2.5 to 70 dBm

Control Voltage (V) 0 5 10 15 20

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10 - 4000 MHz

Typical Performance Curves @ +25°C, 1000 - 5000 MHz, Shunt Bias = 0.75 Volts

**Insertion Loss vs. Frequency**

**Attenuation vs. Control Voltage**

**Input Return Loss vs. Control Voltage**

**Output Return Loss vs. Control Voltage**

**IP3 vs. Control Voltage (10 MHz Spacing)**

**P1dB vs. Control Voltage**