Features

- 3 Terminal LPF Broadband Shunt Structure
- 50 MHz - 12 GHz Broadband Frequency
- >100 W Peak Power Handling
- < 0.1 dB Shunt Insertion Loss
- >23 dB Shunt Isolation
- < 45°C/W Thermal Resistance
- Lead-Free 1.5 x 1.2 mm 6-lead DFN Package
- RoHS* Compliant and 260°C Reflow

Description

The MADP-011027 is a lead-free 1.5 x 1.2 mm DFN surface mount plastic packaged that provides both low and high signal frequency operation from 50 MHz to 12 GHz. The higher breakdown voltage and lower thermal resistance of the PIN diode provides peak power handling in excess of 100 W.

This device is ideally suitable for usage in higher incident power switches, phase shifters, attenuators, and limiter microwave circuits over a broad frequency where higher performance surface mount diode assemblies are required.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MADP-011027-14150T</td>
<td>3000 piece reel</td>
</tr>
<tr>
<td>MADP-011027-000SMB</td>
<td>sample board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.
2. All RF Sample boards include 5 loose parts.
3. M/A-COM Technology Solutions recommends connecting unused package pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC, and thermal ground.

High Power PIN Diode
50 MHz - 12 GHz

Electrical Specifications: $T_A = +25^\circ C$

<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>Forward Voltage</td>
<td>+50 mA D.C.</td>
<td>V</td>
<td>0.7</td>
<td>0.9</td>
<td>1.1</td>
</tr>
<tr>
<td>Reverse Leakage Current</td>
<td>-100 V D.C.</td>
<td>nA</td>
<td>—</td>
<td></td>
<td>-20</td>
</tr>
<tr>
<td>Total Capacitance$^5$</td>
<td>-50 V @ 1 MHz</td>
<td>pF</td>
<td>—</td>
<td>0.24</td>
<td>0.35</td>
</tr>
<tr>
<td>Series Resistance$^6$</td>
<td>+10 mA @ 1 GHz</td>
<td>Ω</td>
<td>—</td>
<td>1.9</td>
<td>2.6</td>
</tr>
<tr>
<td>Parallel Resistance$^6$</td>
<td>-Vdc = -40 V, @ 100 MHz</td>
<td>KΩ</td>
<td>—</td>
<td>500</td>
<td>—</td>
</tr>
<tr>
<td>Minority Carrier Lifetime</td>
<td>+If = 10 mA / -Ir = -6 mA (50% Control Voltage, 90% Output Voltage)</td>
<td>μS</td>
<td>—</td>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>C.W. Thermal Resistance</td>
<td>IHigh = 4 A, Ilow = 10 mA @ 10 kHz</td>
<td>ºC/W</td>
<td>—</td>
<td>45</td>
<td>—</td>
</tr>
<tr>
<td>Power Dissipation$^7,8$</td>
<td>+If = 50 mA @ 1 GHz</td>
<td>W</td>
<td>—</td>
<td>3.3</td>
<td>—</td>
</tr>
<tr>
<td>Insertion Loss</td>
<td>F = 1 GHz, -Vdc = -10 V</td>
<td>dB</td>
<td>—</td>
<td>-0.1</td>
<td>—</td>
</tr>
<tr>
<td>Isolation</td>
<td>F = 1 GHz, +Ibias = +10 mA</td>
<td>dB</td>
<td>—</td>
<td>-23</td>
<td>-21</td>
</tr>
</tbody>
</table>

6. $R_s$ and $R_p$ are measured on an HP4291A Impedance Analyzer.
7. De-rate power dissipation linearly by $-22.2 \text{ mW/}^\circ \text{C}$ to 0 W @ $+175^\circ \text{C}$: $P_{d} = P_{d}(+25^\circ \text{C}) - \Delta P = P_{d}(+25^\circ \text{C}) - (22.2 \text{ mW/}^\circ \text{C}) \Delta T$.
8. $P_D = \Delta T / \Theta$ or $P_D = (IF + IRF)^2 / R_s$, where IF is the forward bias DC current and IRF is the forward bias RMS RF current.

Absolute Maximum Ratings$^{9,10}$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.C. Forward Voltage @ 250 mA</td>
<td>1.2 V</td>
</tr>
<tr>
<td>D.C. Forward Current</td>
<td>250 mA</td>
</tr>
<tr>
<td>D.C. Reverse Voltage</td>
<td></td>
</tr>
<tr>
<td>Junction Temperature$^{11}$</td>
<td>+175°C</td>
</tr>
<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>Re-flow Temperature</td>
<td>+260°C for 360 seconds</td>
</tr>
</tbody>
</table>

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these Class 2 devices.
Assembly Recommendations

Devices may be soldered using standard Pb60/Sn40, or RoHS compliant solders. Leads are plated NiPdAuAg to ensure an optimum solderable connection.

For recommended Sn/Pb and RoHS soldering profile see Application Note M538 on the MACOM website.

Cleanliness and Storage

These devices should be handled and stored in a clean environment. Ends of the device are NiPdAuAg plated for greater solderability. Exposure to high humidity (>80%) for extended periods may cause the surface to oxidize. Caution should be taken when storing devices for long periods.

General Handling

Device can be handled with tweezers or vacuum pickups and are suitable for use with automatic pick-and-place equipment.
Typical 1 GHz Parametric Curves

**Series Resistance vs. Forward Current**

- Graph shows the variation of series resistance ($R_s$) with forward current.
- Resistance decreases as forward current increases.

**Capacitance vs. Reverse Voltage**

- Graph illustrates the capacitance ($C$) change with reverse voltage.
- Capacitance remains relatively constant with increasing reverse voltage.

**Parallel Resistance vs. Reverse Voltage**

- Graph depicts the parallel resistance ($R_p$) against reverse voltage.
- Resistance increases significantly with reverse voltage.

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High Power PIN Diode
50 MHz - 12 GHz

Typical RF Small Signal Performance Curves

**Insertion Loss**

-0.25 to 0 dB

Frequency (GHz)

**Return Loss**

-50 to 0 dB

Frequency (GHz)

**Isolation**

-35 to -10 dB

Frequency (GHz)
**High Power PIN Diode**  
50 MHz - 12 GHz

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**Lead-Free 1.5 x 1.2 mm 6-Lead DFN†**

![Diode Diagram](image)

NOTES:
1. REFERENCE JEDEC MO-153-AB FOR ADDITIONAL DIMENSIONAL AND TOLERANCE INFORMATION.
2. ALL DIMENSIONS SHOWN AS INCHES/MM.

† Reference Application Note S2083 for lead-free solder reflow recommendations. Meets JEDEC moisture sensitivity level 1 requirements. Plating is NiPdAuAg.
Applications Section

Schematic of High Power SP2T Shunt Switch using MADP-011027-14150T PIN Diodes

\[ F = \text{Octave Bandwidth from 1 to 12 GHz} \]
\[ P_{\text{inc}} = +40 \text{ dBm CW} \]
\[ P_{\text{inc}} = +50 \text{ dBm, 10 } \mu \text{s PW, 1 } \% \text{ Duty} \]

\[ L = \frac{11.807}{(\varepsilon_{\text{eff}}^{\frac{1}{2}} \times F \times 4)} \text{ inches, } \theta = \beta \times L = \left(\frac{2 \pi}{\lambda}\right) \times L = 90^\circ \]

Frequency is in GHz, \( \varepsilon_{\text{eff}} \) is Effective Dielectric Constant of Transmission Line Medium

<table>
<thead>
<tr>
<th>RF State</th>
<th>B1 Bias</th>
<th>B2 Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>J0-J1 Low Loss &amp; J0-J2 Isolation</td>
<td>-50 V @ 0 mA</td>
<td>+1 V @ +20 mA</td>
</tr>
<tr>
<td>J0-J2 Low Loss &amp; J0-J1 Isolation</td>
<td>+1 V @ +20 mA</td>
<td>-50 V @ 0 mA</td>
</tr>
</tbody>
</table>
Applications Section

Schematic of 3 Stage Limiter using MADP-011027-14150T
F = 1000 - 8,000 MHz
Pinc = +47 dBm CW
Pinc = +50 dBm, 10 µS P.W., 1 % Duty

<table>
<thead>
<tr>
<th>Part</th>
<th>PN</th>
<th>Case Style</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>MADP-011027-14150T</td>
<td>ODS-1415</td>
<td>Input PIN Diode</td>
<td>1</td>
</tr>
<tr>
<td>D2</td>
<td>MADP-011023-14150T</td>
<td>ODS-1415</td>
<td>2nd Stage PIN Diode</td>
<td>1</td>
</tr>
<tr>
<td>D3</td>
<td>MADP-011023-14150T</td>
<td>ODS-1415</td>
<td>3rd Stage PIN Diode</td>
<td>1</td>
</tr>
<tr>
<td>L1</td>
<td>33 nH</td>
<td>0402</td>
<td>RF Choke / DC Return</td>
<td>1</td>
</tr>
<tr>
<td>C1</td>
<td>27 pF</td>
<td>0402</td>
<td>DC Block</td>
<td>1</td>
</tr>
<tr>
<td>C2</td>
<td>27 pF</td>
<td>0402</td>
<td>DC Block</td>
<td>1</td>
</tr>
</tbody>
</table>
Microwave Model of MADP-011027-14150T

- **Parameter**
  - **Value**
  - Cpackage: 8.0E-14 F
  - Lbond=Lf: 4.0E-10 H
  - Rs: 0.9 Ω
  - Rp: 5E+5 Ω

Rj = Rs (Forward Bias Current)
Rj = Rp (Reverse Bias Voltage)