

MADP-011028-14150T

High Power PIN Diode
50 MHz - 12 GHz

Rev. V3

Features

- 3 Terminal LPF Broadband Shunt Structure
- 50 MHz - 12 GHz Broadband Frequency
- >100 W Peak Power Handling
- < 0.1 dB Shunt Insertion Loss
- >19 dB Shunt Isolation
- < 35°C/W Thermal Resistance
- Lead-Free 1.5 x 1.2 mm 6-lead TDFN Package
- RoHS* Compliant and 260°C Reflow

Description

The MADP-011028 is a lead-free 1.5 x 1.2 mm TDFN 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.

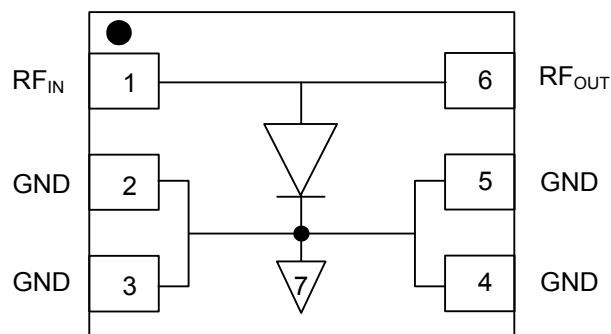
This device is ideally suitable for usage in higher incident power switches, phase shifters, attenuators, and limiter microwave circuits over a broad frequency where higher performance surface mount diode assemblies are required.

Ordering Information^{1,2}

| Part Number | Package |
|--------------------|-----------------|
| MADP-011028-14150T | 3000 piece reel |
| MADP-011028-000SMB | Sample board |

1. Reference Application Note [M513](#) for reel size information.
2. All RF Sample boards include 5 loose parts.

Functional Schematic



Pin Configuration³

| Pin No. | Pin Name | Description |
|---------|---------------------|-------------|
| 1 | RF _{IN} | RF Input |
| 2 | GND | Ground |
| 3 | GND | Ground |
| 4 | GND | Ground |
| 5 | GND | Ground |
| 6 | RF _{OUT} | RF Output |
| 7 | Paddle ⁴ | Ground |

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.

* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

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High Power PIN Diode
50 MHz - 12 GHz

Rev. V3

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

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|--|--|---------------------------|------|------|-------|
| Forward Voltage | +50 mA D.C. | V | 0.7 | 0.9 | 1.1 |
| Reverse Leakage Current | -200 V D.C. | nA | — | -20 | -1000 |
| Total Capacitance ⁵ | -50 V @ 1 MHz | pF | — | 0.24 | 0.30 |
| Series Resistance ⁶ | +10 mA @ 1 GHz | Ω | — | 3.4 | 4.4 |
| Parallel Resistance ⁶ | -Vdc = -40 V, @ 100 MHz | K Ω | — | 500 | — |
| Minority Carrier Lifetime | +If = 10 mA / -Ir = -6 mA (50% Control Voltage, 90% Output Voltage) | μs | — | 2.0 | 3.0 |
| C.W. Thermal Resistance (Infinite Heat Sink at Thermal Ground Plane) | I High = 4 A, I low = 10 mA @ 10 kHz | $^\circ\text{C}/\text{W}$ | — | 35 | — |
| Power Dissipation ^{7,8} (Infinite Heat Sink at Thermal Ground Plane) | +If = 50 mA @ 1 GHz | W | — | 4.3 | — |
| Insertion Loss | F = 1 GHz, -Vdc = -10 V | dB | | 0.05 | |
| Isolation | F = 1 GHz, +I bias = +10 mA | dB | 16.5 | 18.5 | |

5. C_t (Total Capacitance) = C_J (Junction Capacitance) + C_p (Parasitic Package Capacitance).

6. R_s and R_p are measured on an HP4291A Impedance Analyzer.

7. De-rate power dissipation linearly by $-28.6 \text{ mW}/^\circ\text{C}$ to 0 W @ $+175^\circ\text{C}$: $P_d(T) = P_d(+25^\circ\text{C}) - \Delta P = P_d(+25^\circ\text{C}) - (28.6 \text{ mW}/^\circ\text{C})(\Delta T)$.

8. $PD = \Delta T_j / \Theta$ or $PD = (I_F + I_{RF})^2 (R_s)$, where I_F is the forward bias DC current and I_{RF} is the forward bias RMS RF current.

Absolute Maximum Ratings^{9,10}

| Parameter | Absolute Maximum |
|-----------------------------------|---|
| D.C. Forward Voltage @ +250 mA | 1.2 V |
| D.C. Forward Current | 250 mA |
| D.C. Reverse Voltage | -200V |
| Junction Temperature | +175 $^\circ\text{C}$ |
| Operating Temperature | -65 $^\circ\text{C}$ to +125 $^\circ\text{C}$ |
| Storage Temperature | -65 $^\circ\text{C}$ to +150 $^\circ\text{C}$ |
| Re-flow Temperature | +260 $^\circ\text{C}$ for 360 seconds |

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

10. M/A-COM Technology Solutions does not recommend sustained operation near these survivability limits.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

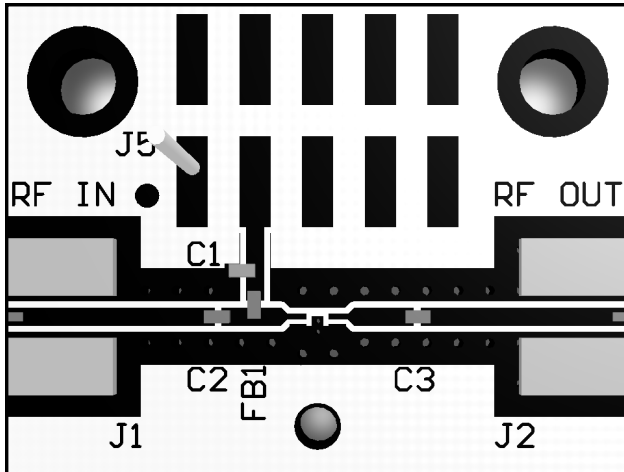
These devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these Class 1B devices.

MADP-011028-14150T

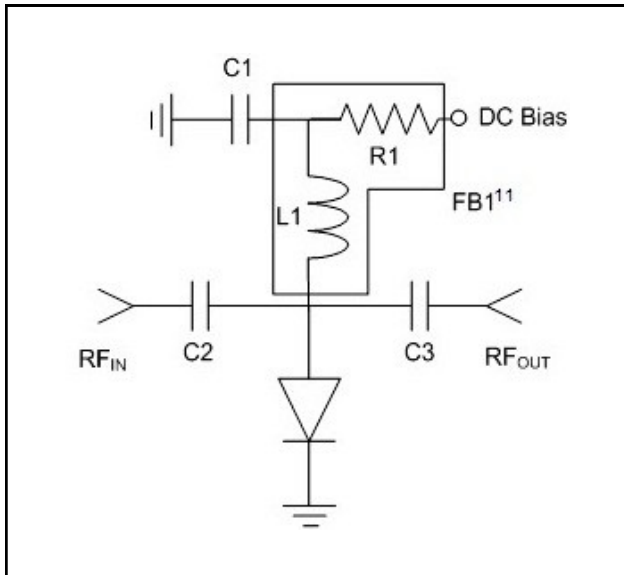
High Power PIN Diode
50 MHz - 12 GHz

Rev. V3

PCB Layout



PCB Schematic



11. R1 is not needed when using the recommended ferrite FB1.

500 - 5000 MHz Parts List¹²

| Part | Value | Case Style |
|--------|----------------------|------------|
| C1 | 62 pF | 0402 |
| C2, C3 | 100 pF | 0402 |
| FB1 | 470 Ω @ 1 GHz | 0402 |
| R1 | 150 Ω | 0402 |
| L1 | 82 nH | 0402 |

12. Max DC voltage with recommended components not to exceed 100 V.

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.

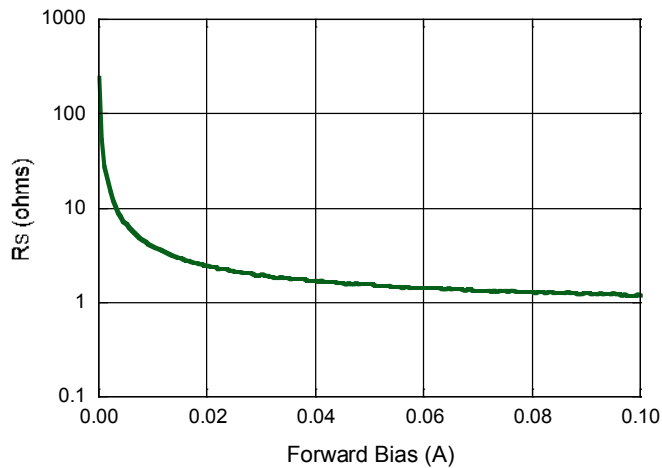
MADP-011028-14150T

High Power PIN Diode
50 MHz - 12 GHz

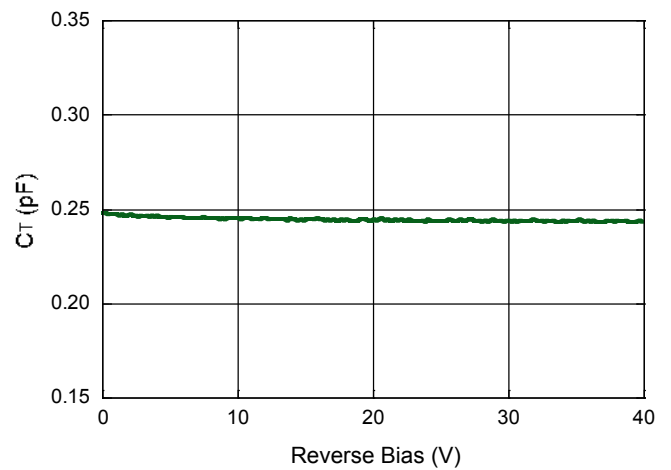
Rev. V3

Typical 1 GHz Parametric Curves

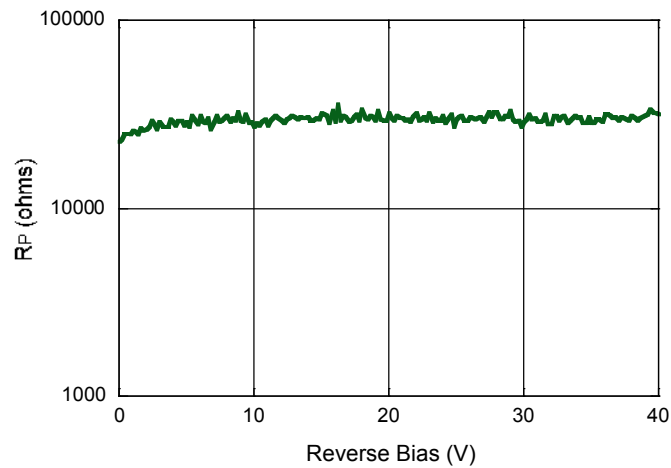
Series Resistance vs. Forward Current



Capacitance vs. Reverse Voltage



Parallel Resistance vs. Reverse Voltage



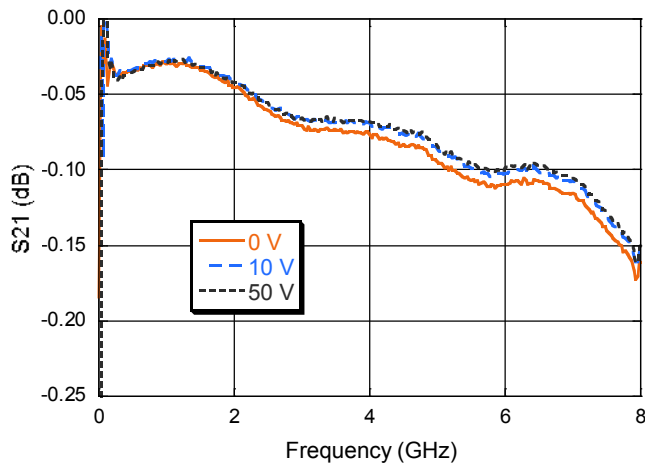
MADP-011028-14150T

High Power PIN Diode
50 MHz - 12 GHz

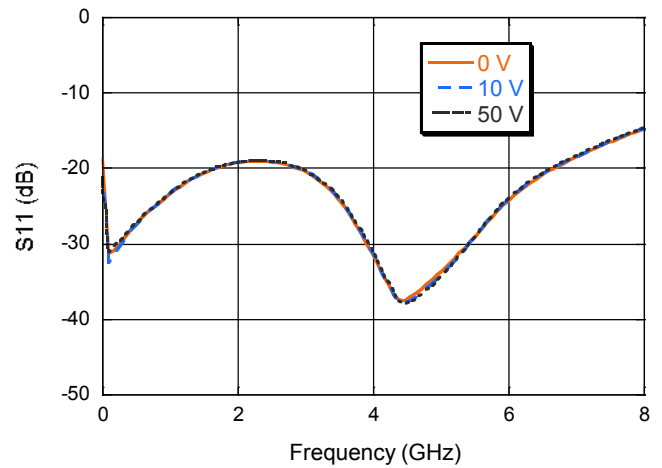
Rev. V3

Typical RF Small Signal Performance Curves

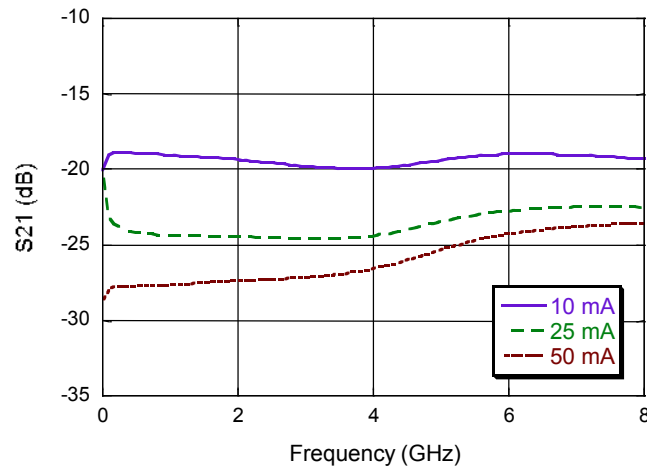
Insertion Loss



Return Loss



Isolation

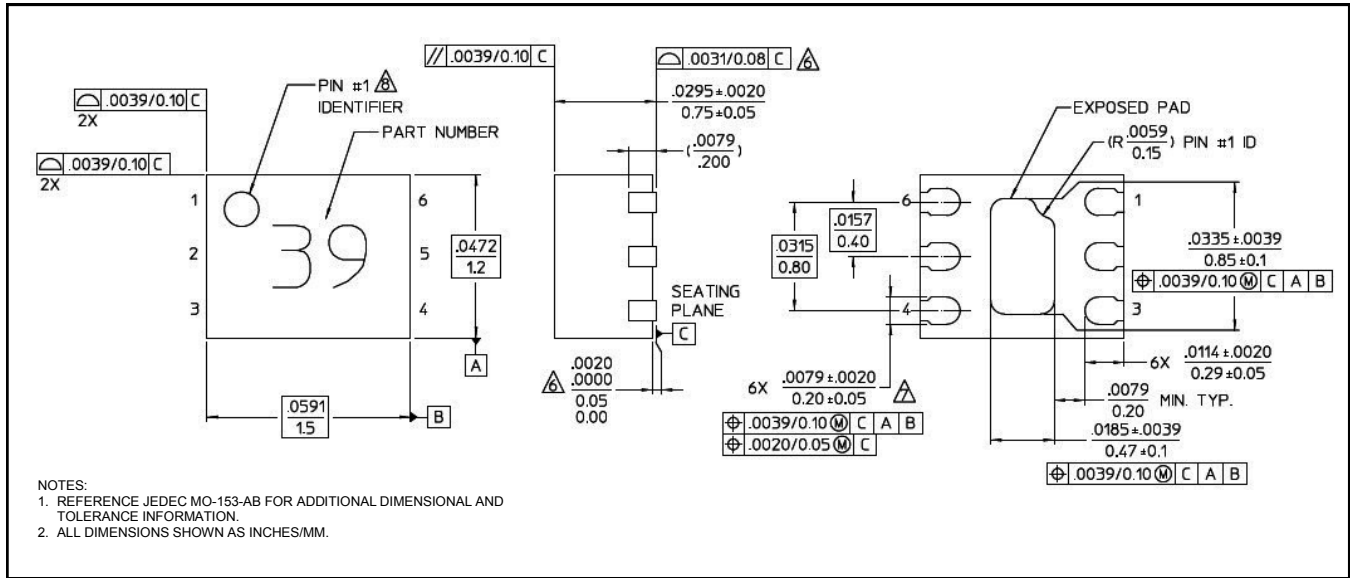


MADP-011028-14150T

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Rev. V3

Lead-Free 1.5 x 1.2 mm 6-Lead TDFN[†]



[†] Reference Application Note [S2083](#) for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is NiPdAuAg.

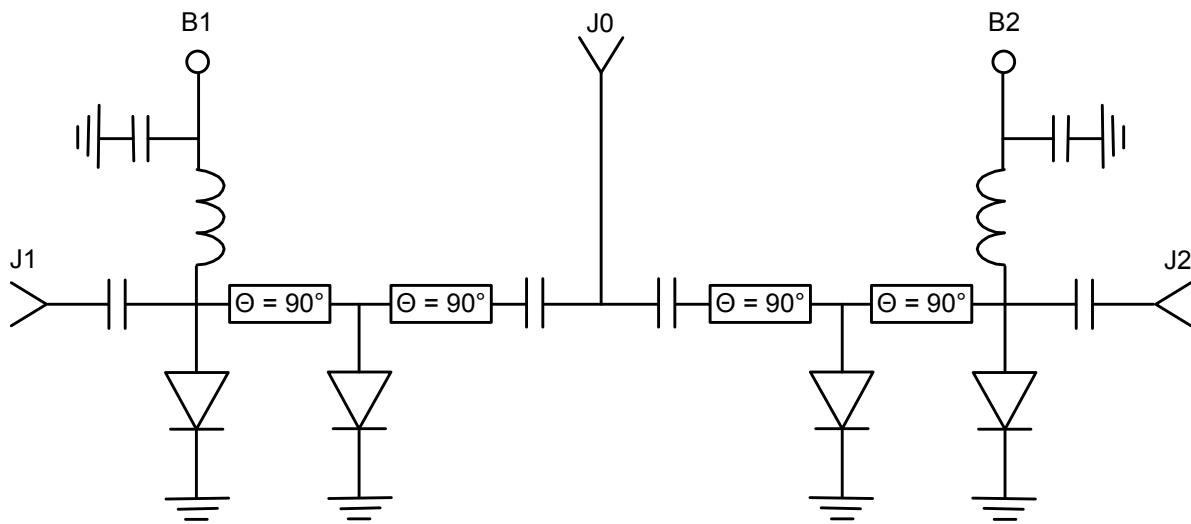
MADP-011028-14150T

High Power PIN Diode
50 MHz - 12 GHz

Rev. V3

Applications Section

Schematic of High Power SP2T Shunt Switch using MADP-011028-14150T PIN Diodes
F = Octave Bandwidth from 1 to 12 GHz
 $P_{inc} = +40$ dBm CW
 $P_{inc} = +50$ dBm, $10 \mu s$ PW, 1 % Duty



$$L = 11.807 / (\epsilon_{eff}^{1/2} * F * 4) \text{ inches, } \theta = \beta * L = (2 \pi / \lambda) * L = 90^\circ$$

Frequency is in GHz, ϵ_{eff} is Effective Dielectric Constant of Transmission Line Medium

| RF State | B1 Bias | B2 Bias |
|----------------------------------|---------------|---------------|
| J0-J1 Low Loss & J0-J2 Isolation | -50 V @ 0 mA | +1 V @ +20 mA |
| J0-J2 Low Loss & J0-J1 Isolation | +1 V @ +20 mA | -50 V @ 0 mA |

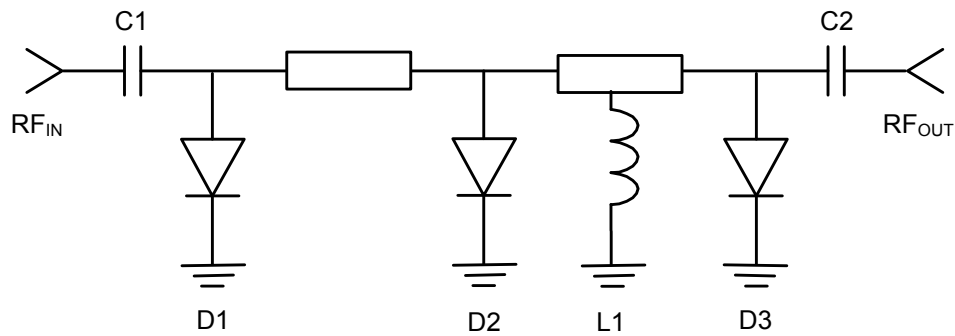
MADP-011028-14150T

High Power PIN Diode
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Rev. V3

Applications Section

Schematic of 3 Stage Limiter using MADP-011028-14150T
 $F = 1000 - 8,000 \text{ MHz}$
 $P_{inc} = +47 \text{ dBm CW}$
 $P_{inc} = +50 \text{ dBm, } 10 \mu\text{s P.W., } 1 \% \text{ Duty}$



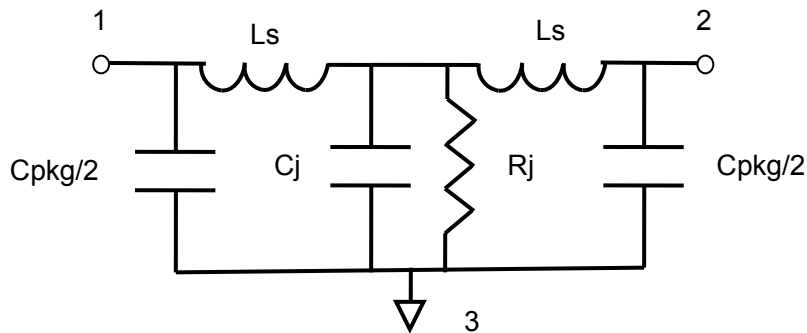
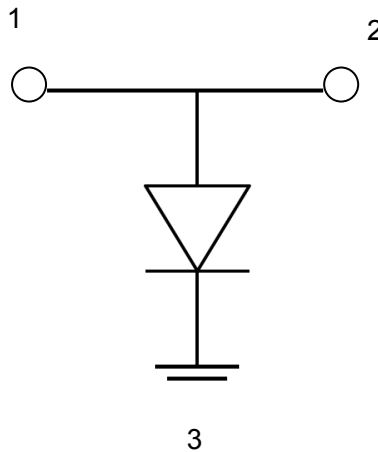
| Part | PN | Case Style | Description | Quantity |
|------|--------------------|------------|----------------------|----------|
| D1 | MADP-011028-14150T | ODS-1415 | Input PIN Diode | 1 |
| D2 | MADL-011023-14150T | ODS-1415 | 2nd Stage PIN Diode | 1 |
| D3 | MADL-011023-14150T | ODS-1415 | 3rd Stage PIN Diode | 1 |
| L1 | 33 nH | 0402 | RF Choke / DC Return | 1 |
| C1 | 27 pF | 0402 | DC Block | 1 |
| C2 | 27 pF | 0402 | DC Block | 1 |

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Rev. V3

Microwave Model of MADP-011028-14150T



$R_j = R_s$ (Forward Bias Current)

$R_j = R_p$ (Reverse Bias Voltage)

| Parameter | Value |
|----------------------|---------------|
| C_{package} | 8.0E-14 F |
| L bond = L_s | 4.0E-10 H |
| R_s | 0.9 Ω |
| R_p | 5E+5 Ω |

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