

## DATA SHEET

# SMP1321-085LF: Surface-Mount PIN Diode for Switch and Attenuator Applications

## Applications

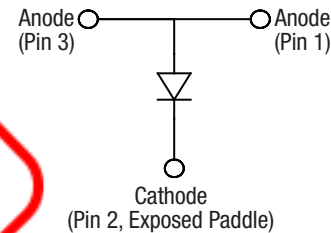
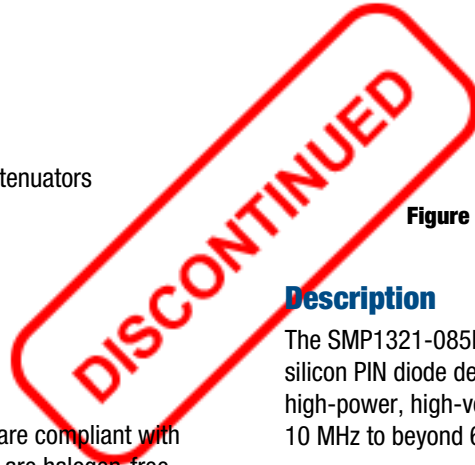
- Low-loss, high-power switches
- Low-distortion attenuators

## Features

- Low thermal resistance: 59 °C/W
- Suitable component for RF switches or attenuators
- Low capacitance: 0.27 pF typical @ 30 V
- Low distortion performance
- QFN (3-pin, 2 x 2 mm) package (MSL1, 260 °C per JEDEC J-STD-020)



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203498-001

**Figure 1. SMP1321-085LF Block Diagram**

## Description

The SMP1321-085LF is a surface-mountable, low-capacitance silicon PIN diode designed as a shunt connected PIN diode for high-power, high-volume switch and attenuator applications from 10 MHz to beyond 6 GHz.

Maximum resistance at 10 mA is 2.0  $\Omega$ , and maximum capacitance at 30 V is 0.35 pF. The combination of low junction capacitance, low parasitic inductance, low thermal resistance, and nominal 15  $\mu\text{m}$  I-region width, makes the SMP1321-085LF useful in large signal switches and attenuator applications.

The device has a 1.4 W dissipation power rating, making it capable of handling more than 35 W continuous wave (CW) and 350 W peak (1  $\mu\text{s}$  pulse, 1 percent duty cycle,  $T_C = 85^\circ\text{C}$ ) in a shunt-connected transmit/receive (T/R) switch.

Design information for high-power switches can be found in the Skyworks Application Note, *Design With PIN Diodes* (document number 200312).

A block diagram of the SMP1321-085LF is shown in Figure 1.

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SMP1321-085LF are provided in Table 1. Electrical specifications are provided in Table 2.

A plot of series resistance versus forward current is shown in Figure 2.

**Table 1. SMP1321-085LF Absolute Maximum Ratings<sup>1</sup>**

Parameter	Symbol	Minimum	Maximum	Units
Reverse voltage	$V_R$		100	V
Forward current @ 25 °C	$I_F$		200	mA
CW power dissipation @ 85 °C	$P_D$		1.4	W
Peak pulse power dissipation @ 85 °C (10% duty cycle)			140	W
Storage temperature	$T_{STG}$	-65	+200	°C
Operating temperature	$T_A$	-40	+150	°C

<sup>1</sup> Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

**ESD HANDLING:** Although this device is designed to be as robust as possible, electrostatic discharge (ESD) can damage this device. This device must be protected at all times from ESD when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.

**Table 2. SMP1321-085LF Electrical Specifications<sup>1</sup>**

( $T_A = +25$  °C Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Reverse current	$I_R$	$V_R = 100$ V			10	$\mu$ A
Capacitance	$C_T$	$f = 1$ MHz, $V_R = 30$ V		0.27	0.35	pF
Resistance	$R_S$	$f = 100$ MHz: $I_F = 1$ mA $I_F = 10$ mA		3.2 1.2	2.0	$\Omega$ $\Omega$
Forward voltage	$V_F$	$I_F = 1$ mA		0.77		V
Carrier lifetime	$T_L$	$I_F = 10$ mA		400		ns
I region width	$W$			15		$\mu$ m
CW thermal resistance <sup>2</sup>	$\theta_{JC}$				59	°C/W

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.

<sup>2</sup> Measurement based on a thermal resistance of 92 °C/W for the junction-to-bottom of circuit board.

## Typical Performance Characteristics

( $T_A = 25^\circ\text{C}$ , Unless Otherwise Noted)

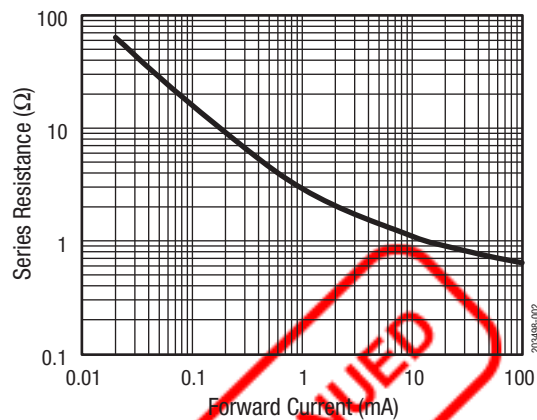


Figure 2. Series Resistance vs Current @ 100 MHz

## High-Power Switch Design Applications

The SMP1321-085LF PIN diode is designed for shunt applications such as reflective switches or shunt-diode attenuator circuits. Compared to other surface-mount packages, the design of the QFN package produces lower thermal resistance and also reduces the effects of the parasitic inductance of the anode bond wires.

A cross-sectional view of the SMP1321-085LF PIN diode is shown in Figure 3. The cathode of the die is soldered directly to the top of the exposed paddle. This paddle is composed of copper, so its thermal resistance is very low.

The copper ground paddle minimizes the total thermal resistance between the I layer, which is the location where most heat is generated under normal operation, and the surface to which the package is mounted. Minimal thermal resistance between the I layer and the external environment minimizes junction temperature.

The electrically equivalent circuit of the SMP1321-085LF PIN diode is shown in Figure 4. The inductances of pins 1 and 2, as well as the inductances of the bond wires are in series with the input and output transmission lines of the external circuit rather than the portion of the circuit that contains the shunt PIN diode.

The effects of these parasitic series inductances are negligible, since they add a very small insertion loss to the shunt PIN but have no effect on the isolation that the diode produces when it is forward biased.

A cross section of the suggested printed circuit board design is shown in Figure 5. The via shown in this view is critical, both for electrical performance and for thermal performance. It is recommended that several vias should be placed under the entire footprint of the exposed paddle (pin 2) to minimize both electrical inductance to the system ground and thermal resistance to the system heat sink.

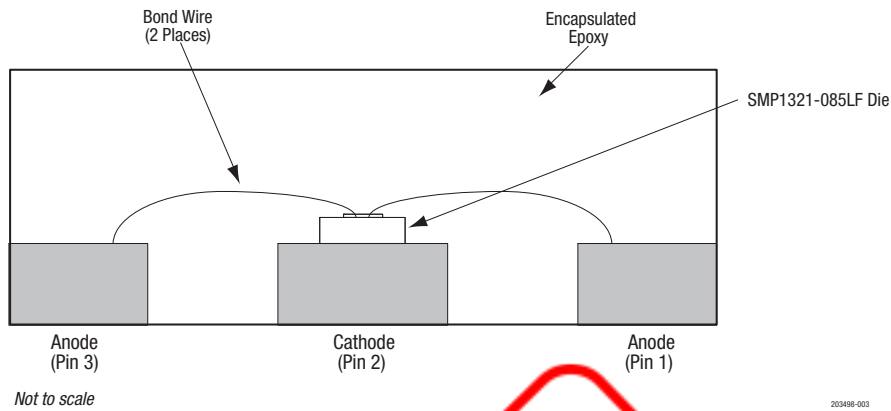


Figure 3. Cross-Sectional View of the SMP1321-085LF

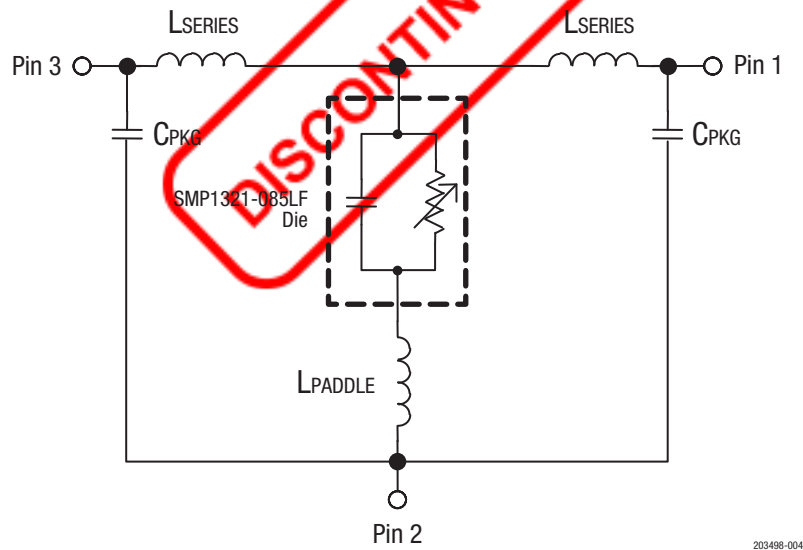


Figure 4. SMP1321-085LF Electrically Equivalent Circuit

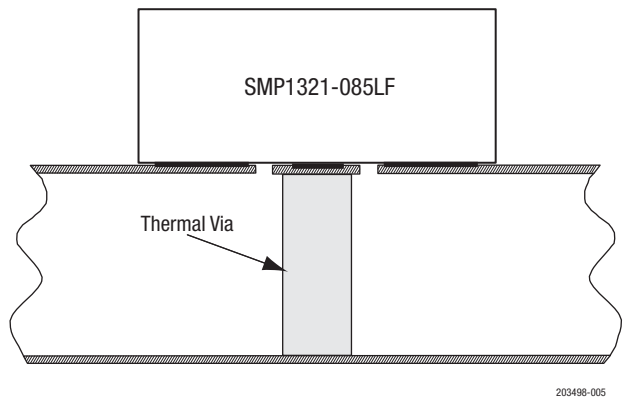


Figure 5. Cross-Sectional View of Suggested Printed Circuit Board

## Package Dimensions

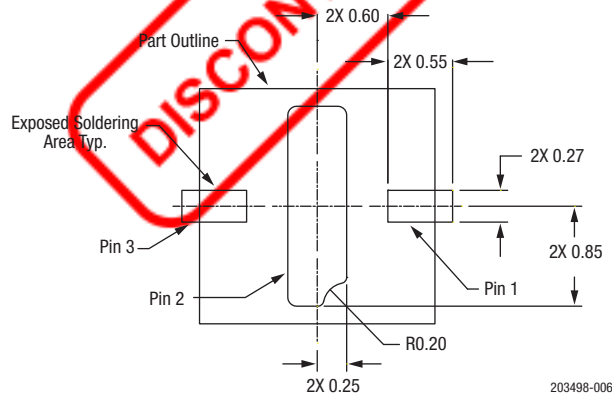
The PCB layout footprint for the SMP1321-085LF is shown in Figure 6. Typical part markings are shown in Figure 7. Package dimensions are provided in Figure 8, and Figure 9 provides the tape and reel dimensions.

## Package and Handling Information

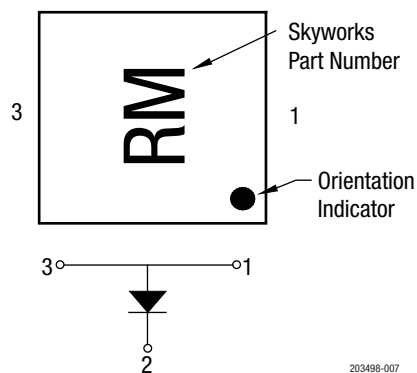
Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SMP1321-085LF is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.



**Figure 6. SMP1321-085LF PCB Layout Footprint**



**Figure 7. Typical Part Markings  
(Top View)**

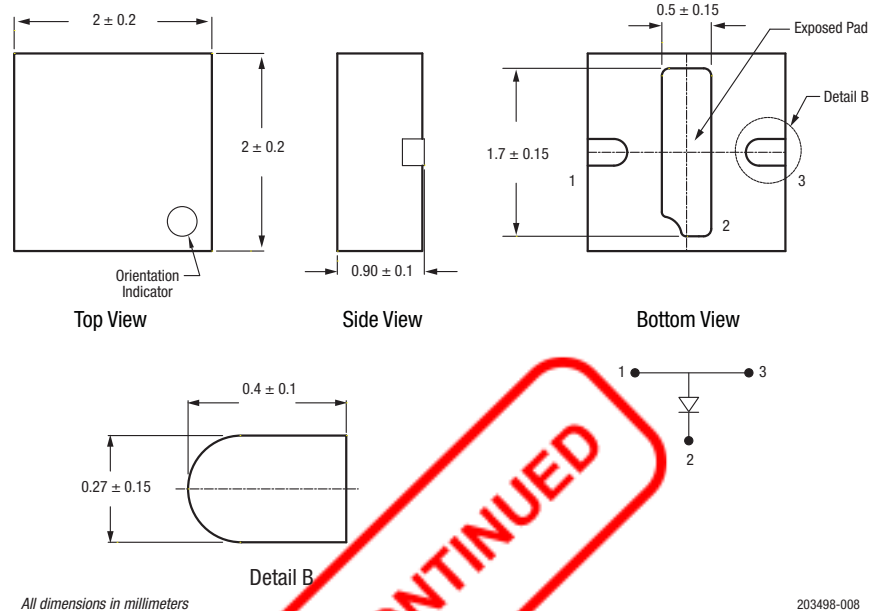


Figure 8. SMP1321-085LF Package Dimension Drawing

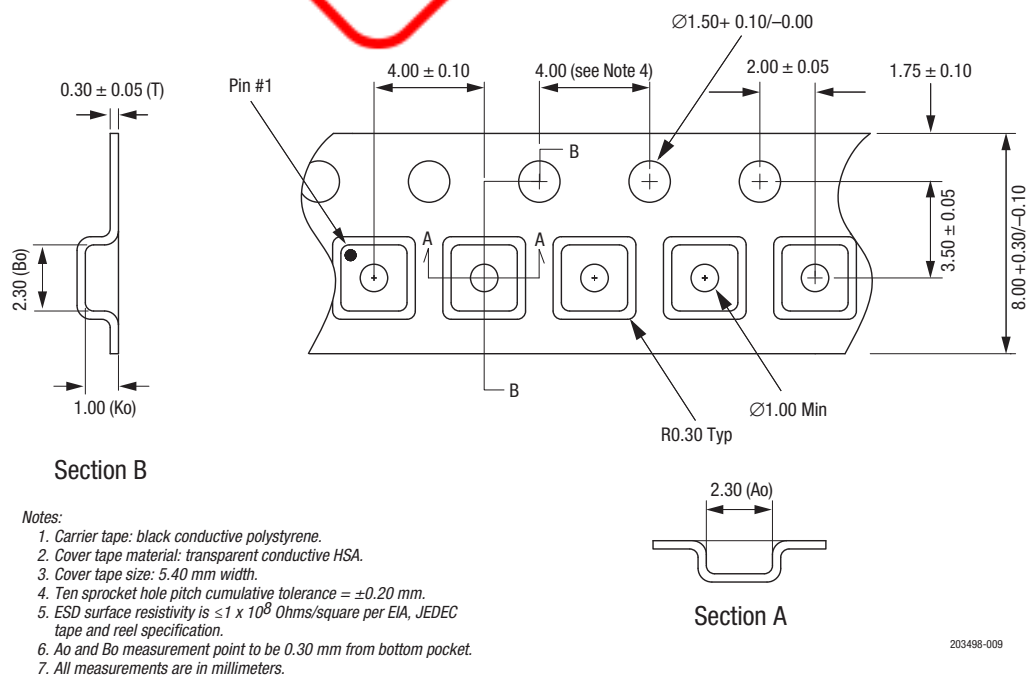


Figure 9. SMP1321-085LF Tape and Reel Dimensions

## Ordering Information

Model Name	Manufacturing Part Number
SMP1321-085LF: Surface-Mount PIN Diode	SMP1321-085LF



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