SKYWORKS™

**DATA SHEET**

# SMP1320 Series: Low Resistance Low Capacitance Plastic Packaged PIN Diodes

## Features

- Designed for high performance wireless switch applications
- 0.9 Ω resistance, 0.3 pF capacitance
- Available lead (Pb)-free MSL-1 @ 250°C per JEDEC J-STD-020
- Available in lead (Pb)-free packaging

## Description

The SMP1320 series of plastic packaged, surface mountable PIN diodes is designed for high volume switch applications from 10 MHz to beyond 2 GHz. The low current performance of these diodes (0.9 Ω maximum at 10 mA and 2 Ω typical at 1 mA) make the SMP1320 series particularly suited to battery operated circuits. Available in a selection of plastic packages and in a variety of configurations including a low inductance (0.4 nH) SOT-23 (SMP1320-007), the small footprint SC-79 and the miniature SC-70.

**NEW** Skyworks offers lead (Pb)-free "environmentally friendly" packaging that is RoHS compliant (European Parliament for the Restriction of Hazardous Substances).


## Absolute Maximum Ratings

| Characteristic | Value |
|---|---|
| Reverse voltage ($V_R$) | 50 V |
| Power dissipation @ 25 °C lead temperature ($P_D$) | 250 mW |
| Storage temperature ($T_{ST}$) | -65 °C to +150 °C |
| Operating temperature ($T_{OP}$) | -65 °C to +150 °C |
| ESD human body model | Class 1B |

Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void the warranty.

***CAUTION:*** *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. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions must be employed at all times.*

|  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| Single | Common Anode | Common Cathode | Series Pair | Low Inductance | Single | Ultra Low Inductance | Single |
| SOT-23 | SOT-23 | SOT-23 | SOT-23 | SOT-23 | SOD-323 | SOT-143 | SC-79 |
| **SMP1320-001** | **SMP1320-003** | **SMP1320-004** | **SMP1320-005** | **SMP1320-007** | **SMP1320-011** | **SMP1320-017** | **SMP1320-079** |
| Marking: PL1 | Marking: PL9 | Marking: PL3 | Marking: PL2 | Marking: PLB | Marking: PL | Marking: PLF | |
| **SMP1320-001LF** | | | | **SMP1320-007LF** | **SMP1320-011LF** | | **SMP1320-079LF** |
| Marking: RL1 | | | | Marking: RLB | Marking: RL | | |
| $L_S$ = 1.5 nH | $L_S$ = 1.5 nH | $L_S$ = 1.5 nH | $L_S$ = 1.5 nH | $L_S$ = 0.4 nH | $L_S$ = 1.5 nH | $L_S$ = 0.2 nH | $L_S$ = 0.7 nH |
| | | SC-70 | SC-70 | SC-70 | | | |
| | | **SMP1320-074** | **SMP1320-075** | **SMP1320-077** | | | |
| | | $L_S$ = 1.4 nH | $L_S$ = 1.4 nH | $L_S$ = 0.4 nH | | | |

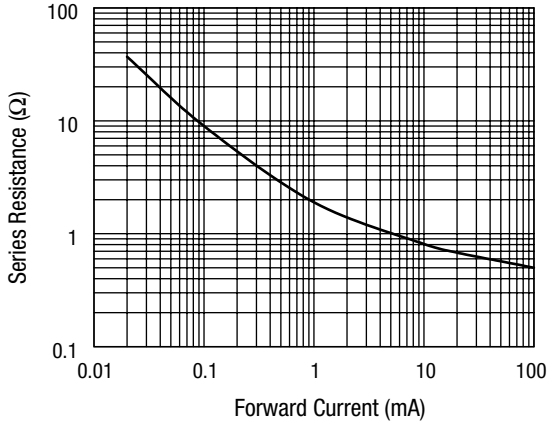
LF denotes lead (Pb)-free packaging option as an alternative to our standard tin/lead (Sn/Pb) packaging.

## Electrical Specifications at 25 °C

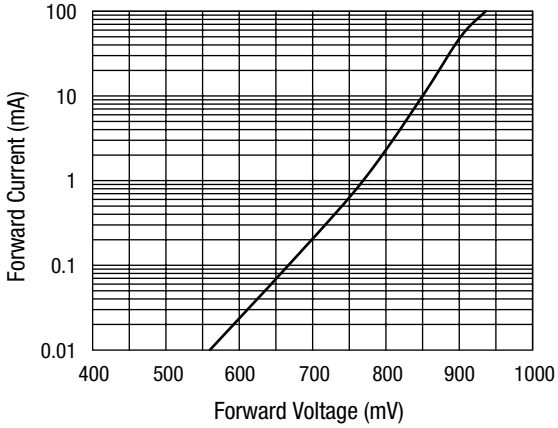
| Parameter | Condition | Typ. | Max. | Unit |
|---|---|---|---|---|
| Reverse current ($I_R$) | $V_R$ = 50 V | | 10 | µA |
| Capacitance ($C_T$)[1] | F = 1 MHz, V = 30 V | | 0.30 | pF |
| Resistance ($R_S$) | F = 100 MHz, I = 1 mA | 2.0 | | Ω |
| Resistance ($R_S$) | F = 100 MHz, I = 10 mA | | 0.9 | Ω |
| Forward voltage ($V_F$) | $I_F$ = 10 mA | 0.85 | | V |
| Carrier lifetime (TI) | $I_F$ = 10 mA | 0.4 | | µs |
| I region width | | 8 | | µm |

1. $C_T$ @ 30 V is 0.45 pF maximum for the SMP1320-007, SMP1320-007LF, and SMP1320-077. $C_T$ @ 30 V is 0.5 pF maximum for the SMP1320-017.

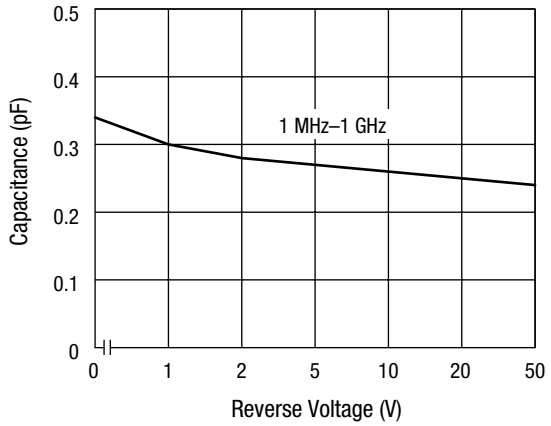
## Typical Performance Data



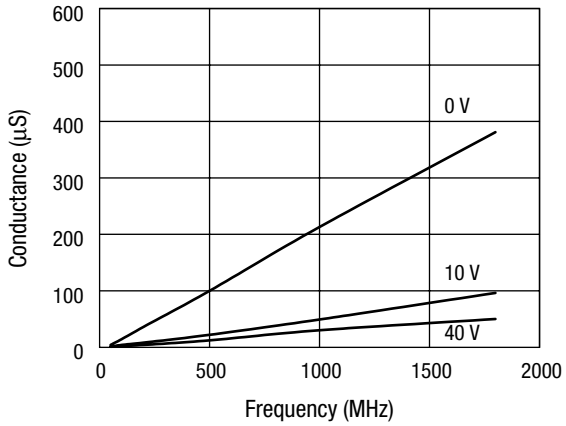

**Series Resistance vs. Current @ 100 MHz**




**DC Characteristic**




**Capacitance vs. Reverse Voltage**

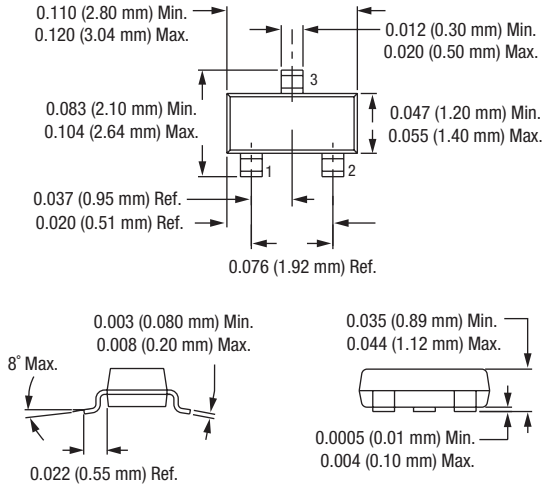



**Conductance vs. Frequency and Reverse Voltage**

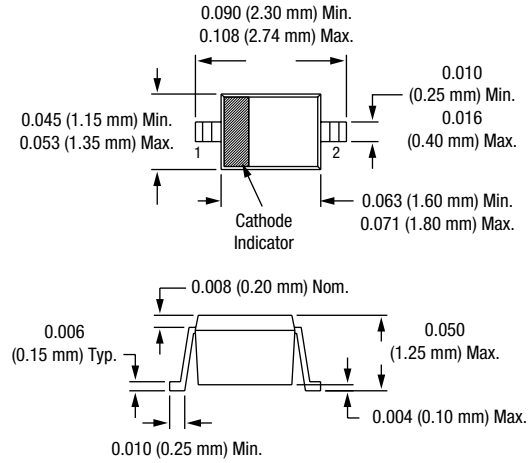
## Resistance vs. Temperature @ 500 MHz

| $I_F$ (mA) | $R_S$ -55 °C (Ω) | $R_S$ -15 °C (Ω) | $R_S$ +25 °C (Ω) | $R_S$ +65 °C (Ω) | $R_S$ +100 °C (Ω) |
|---|---|---|---|---|---|
| 0.02 | 29.60 | 29.20 | 30.80 | 32.00 | 32.70 |
| 0.10 | 7.20 | 7.70 | 8.30 | 8.80 | 8.80 |
| 0.30 | 3.40 | 3.60 | 3.80 | 4.00 | 4.10 |
| 0.50 | 2.50 | 2.70 | 2.80 | 2.90 | 3.00 |
| 1.00 | 1.70 | 1.80 | 1.90 | 2.00 | 1.90 |
| 10.00 | 0.84 | 0.85 | 0.76 | 0.76 | 0.67 |
| 20.00 | 0.73 | 0.73 | 0.64 | 0.64 | 0.56 |
| 100.00 | 0.59 | 0.57 | 0.47 | 0.48 | 0.40 |

## SOT-23



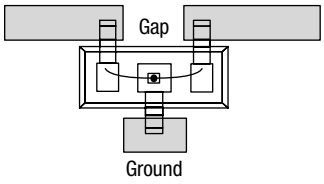

## SOD-323



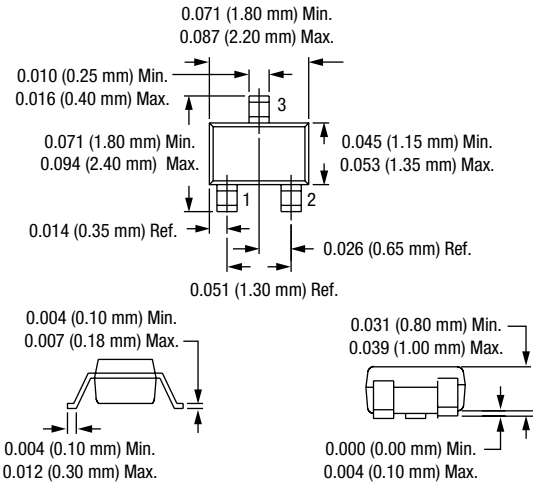

## SMP1320-007

In the -007 configuration of the SOT-23 package, the package inductance is effectively reduced to 0.4 nH, in comparison to the 1.5 nH value of the standard configuration. This lower inductance will be particularly beneficial when the diodes are used as shunt connected switches at frequencies higher than 500 MHz, where inductance is the primary limitation on maximum switch isolation.

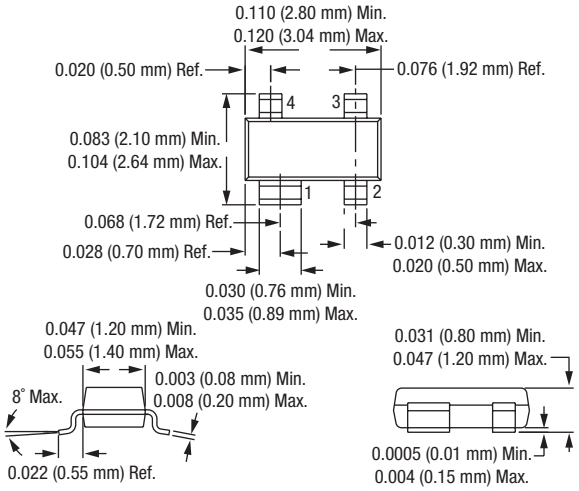
To achieve the effective 0.4 nH, the SOT-23 package must be inserted in the microstrip circuit board with a gap in the trace, as shown in the figure. Because of the polarity of the diode junction, this low inductance feature is only realizable with the cathode connected to ground.



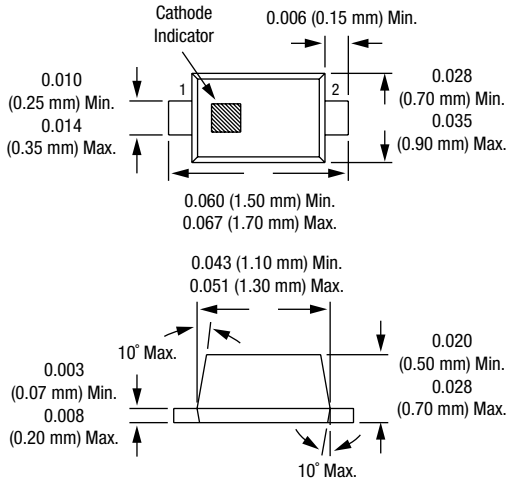

## SC-70



## SOT-143


0.110 (2.80 mm) Min.
0.120 (3.04 mm) Max.
0.020 (0.50 mm) Ref.
0.076 (1.92 mm) Ref.
4
3
0.083 (2.10 mm) Min.
0.104 (2.64 mm) Max.
1
2
0.068 (1.72 mm) Ref.
0.028 (0.70 mm) Ref.
0.012 (0.30 mm) Min.
0.020 (0.50 mm) Max.
0.030 (0.76 mm) Min.
0.035 (0.89 mm) Max.
0.047 (1.20 mm) Min.
0.055 (1.40 mm) Max.
8° Max.
0.003 (0.08 mm) Min.
0.008 (0.20 mm) Max.
0.022 (0.55 mm) Ref.
0.031 (0.80 mm) Min.
0.047 (1.20 mm) Max.
0.0005 (0.01 mm) Min.
0.004 (0.15 mm) Max.

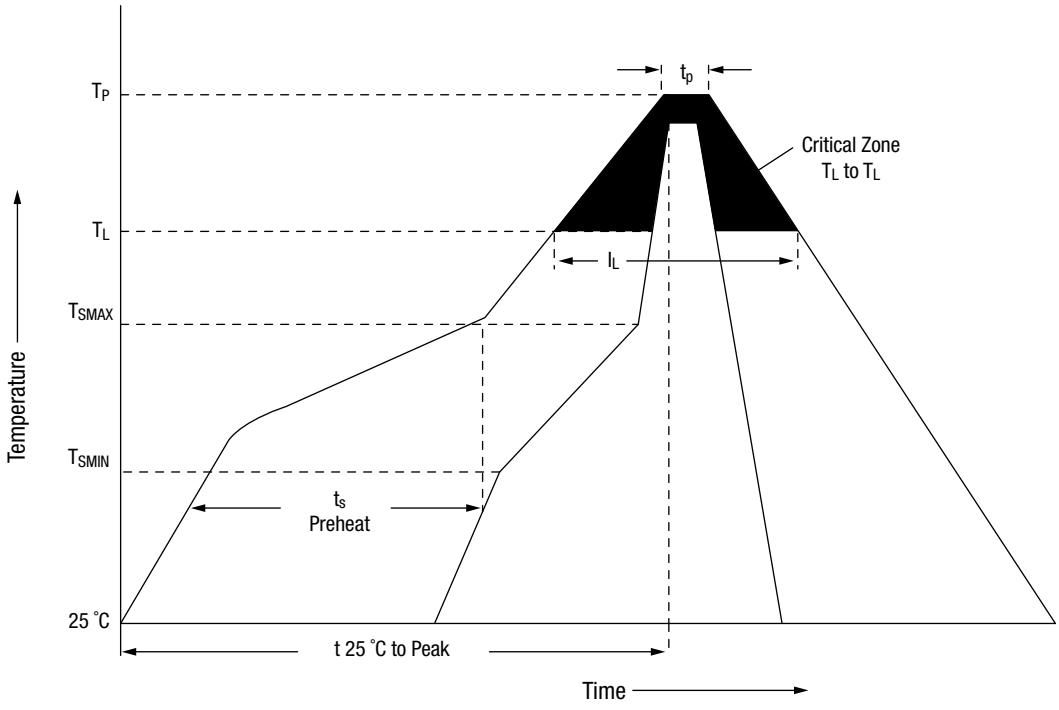
## SC-79


Cathode
Indicator
0.006 (0.15 mm) Min.
0.010
(0.25 mm) Min.
0.014
(0.35 mm) Max.
1
2
0.028
(0.70 mm) Min.
0.035
(0.90 mm) Max.
0.060 (1.50 mm) Min.
0.067 (1.70 mm) Max.
0.043 (1.10 mm) Min.
0.051 (1.30 mm) Max.
10° Max.
0.003
(0.07 mm) Min.
0.008
(0.20 mm) Max.
0.020
(0.50 mm) Min.
0.028
(0.70 mm) Max.
10° Max.

## Recommended Solder Reflow Profiles

| Profile Feature | SnPb Eutectic Assembly | Lead (Pb)-Free Assembly 100% Sn |
|---|---|---|
| Average ramp-up rate ($T_L$ to $T_P$) | 3 °C/second max. | 3 °C/second max. |
| Preheat<br>Temperature min. ($T_{SMIN}$)<br>Temperature max. ($T_{SMAX}$)<br>Time (min. to max.) (ts) | <br>100 °C<br>150 °C<br>60–120 seconds | <br>150 °C<br>200 °C<br>60–80 seconds |
| $T_{SMAX}$ to $T_L$<br>Ramp-up rate | <br>— | <br>3 °C/second max. |
| Time maintained above:<br>Temperature ($T_L$)<br>Time ($t_L$) | <br>183 °C<br>60–150 seconds | <br>217 °C<br>60–150 seconds |
| Peak temperature ($T_P$) | 240 +0/-5 °C | 250 +0/-5 °C |
| Time within 5 °C of actual peak temperature (tp) | 10–30 seconds | 20–40 seconds |
| Ramp-down rate | 6 °C/second max. | 6 °C/second max. |
| Time 25 °C to peak temperature | 6 minutes max. | 8 minutes max. |

All temperatures refer to the topside of the package, measured on the package body surface.
Reference JEDEC J-STD-020B.




Reference JEDEC J-STD-020