

DATA SHEET

# SMP1304 Series: Low-Distortion Attenuator Plastic Packaged PIN Diodes

## Applications

- TV distribution
- Attenuator circuits

## Features

- Low-distortion design
- Frequency range from 5 MHz to >2 GHz
- Designed for base station applications
- Configured for PI and TEE attenuators
- Packages rated MSL1 @ 260 °C per JEDEC J-STD-020



Skyworks offers lead (Pb)-free RoHS (Restriction of Hazardous Substances) compliant packaging.



## Description

The SMP1304 series of plastic packaged, surface mountable, low capacitance (0.3 pF) silicon PIN diodes is designed for attenuator applications from 5 MHz to beyond 2 GHz.

The thick 100  $\mu\text{m}$  I region of these PIN diodes makes them very attractive for use in low-distortion PI and TEE attenuators commonly found in TV distribution applications.

The 1  $\mu\text{s}$  typical carrier lifetime of these diodes results in a resistance of 20  $\Omega$  maximum at 1 mA and 7  $\Omega$  maximum at 10 mA.

The SMP1304 series is available in a selection of plastic packages: as a single diode in a small footprint SOD-323 package, and in a variety of configurations in an SOT-23 package, including the low inductance (0.4 nH) SMP1304-007.

The SMP1304-019, a three-diode junction designed for insertion in PI attenuators, is available in an SOT-143 package. The SMP1304-027 is available in an SOT-5 package as a four-diode array designed for insertion in commonly used four-diode PI attenuator circuits.

Table 1 describes the various packages and marking of the SMP1304 series.

**Table 1. SMP1304 Series Packaging and Marking**

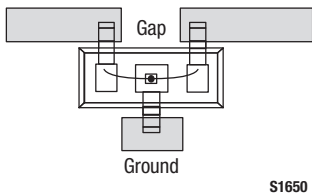
Single	Common Cathode	Series Pair	Reverse Series Pair	Low Inductance	Single	PI	PI
SOT-23	SOT-23	SOT-23	SOT-23	SOT-23	SOD-323	SOT-143	SOT-5
SMP1304-001 Marking: PG1	SMP1304-004 Marking: PG3	SMP1304-005 Marking: PG2		SMP1304-007 Marking: PGB		SMP1304-019 Marking: PGJ	SMP1304-027 Marking: PGM
SMP1304-001LF Marking: RG1	SMP1304-004LF Marking: RG3	SMP1304-005LF Marking: RG2	SMP1304-006LF Marking: RG8	SMP1304-007LF Marking: RGB	◆ SMP1304-011LF Marking: RG	SMP1304-019LF Marking: RGJ	SMP1304-027LF Marking: RGM
$L_S = 1.5 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.4 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.5 \text{ nH}$

LF denotes lead (Pb)-free, RoHS-compliant packaging option as an alternative to their standard Skyworks tin/lead (Sn/Pb) packaging.  
 Innovation to Go™  
 Select Linear Products (indicated by ◆) now available for purchase online.

**SMP1304-007**

The inductance of the SMP1304-007 is effectively reduced to 0.4 nH compared to the 1.5 nH of the standard configuration. The lower inductance is particularly beneficial when the diodes are used as shunt-connected switches at frequencies >500 MHz where inductance is the primary limitation on maximum switch isolation.

To achieve the effective 0.4 nH, the SMP1304-007 must be inserted in the microstrip circuit board with a gap in the trace as shown in Figure 1. Because of the polarity of the diode junction, the low inductance can only be achieved with the cathode connected to ground.



**Figure 1. SOT-23 Package Trace Gap**



**Figure 2. SMP1304-019 Package (PI)**

**SMP1304-019 PI Attenuator PIN Diodes**

The SMP1304-019 uses three PIN diode junctions in an SOT-143 package (see Figure 2). The junctions are configured for ease of

insertion in PI attenuator circuits in common use from 10 MHz to >1 GHz. The SMP1304-019 PIN diode junction was designed for low capacitance, a wide resistance dynamic range, and low distortion performance.

**Electrical and Mechanical Specifications**

The absolute maximum ratings of the SMP1304 series are provided in Table 2. Electrical specifications are provided in Table 3. Resistance versus temperature measurements are provided in Table 4.

Typical performance characteristics of the SMP1304 series are illustrated in Figures 3 to 6. Package dimensions are shown in Figures 7 to 10.

**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 SMP1304 series 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. For packaging details, refer to the Skyworks Application Note *Discrete Devices and IC Switch/Attenuators Tape and Reel Package Orientation*, document number 200083.

**Table 2. SMP1304 Series Absolute Maximum Ratings**

Parameter	Symbol	Minimum	Maximum	Units
Reverse voltage	$V_R$		200	V
Power dissipation @ 25 °C lead temperature	$P_D$		250	mW
Storage temperature	$T_{STG}$	-65	+150	°C
Operating temperature	$T_A$	-65	+150	°C

**Note:** 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.

**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 should be used at all times. The SMP1304 series PIN diodes are Class 1C ESD devices.

**Table 3. SMP1304 Series Electrical Specifications (Note 1)****( $T_A = +25\text{ °C}$ , Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Typical	Max	Units
Reverse Current	$I_R$	$V_R = 200\text{ V}$		10	$\mu\text{A}$
Capacitance (Note 2)	$C_T$	$f = 1\text{ MHz}, V = 30\text{ V}$		0.3	pF
Resistance	$R_S$	$f = 100\text{ MHz}$ $I = 1\text{ mA}$ $I = 10\text{ mA}$ $I = 100\text{ mA}$	40	50 7 2	$\Omega$ $\Omega$ $\Omega$
Forward voltage	$V_F$	$I_F = 10\text{ mA}$	0.8		V
Carrier lifetime	$T_I$	$I_F = 10\text{ mA}$	1		$\mu\text{s}$
I region width			100		$\mu\text{m}$

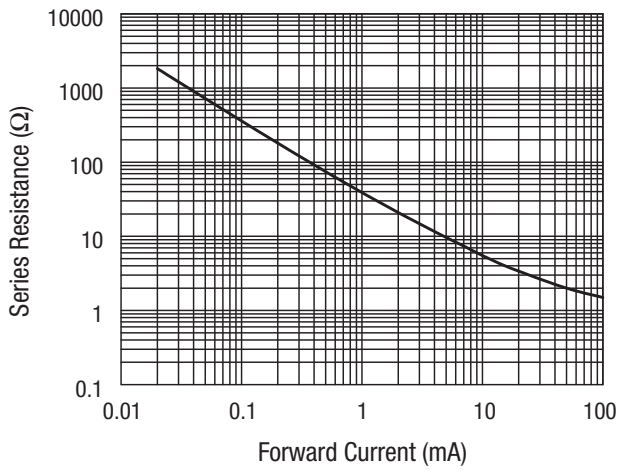
**Note 1:** Performance is guaranteed only under the conditions listed in this Table.

**Note 2:** The SMP1304-019 and SMP1304-027 maximum capacitance is 0.45 pF.

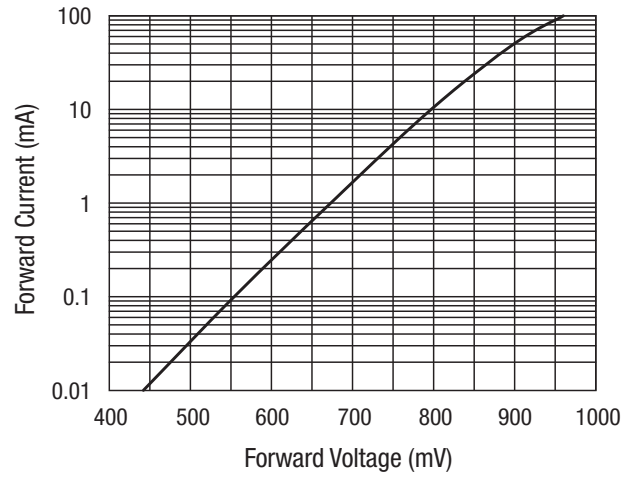
**Table 4. Resistance vs Temperature @ 100 MHz**

$I_F$ (mA)	$R_S$ @ -55 °C ( $\Omega$ )	$R_S$ @ -15 °C ( $\Omega$ )	$R_S$ @ +25 °C ( $\Omega$ )	$R_S$ @ +65 °C ( $\Omega$ )	$R_S$ @ +100 °C ( $\Omega$ )
0.02	1590	1660	1752	1770	1760
0.10	315	340	367	396	409
0.30	108	118	128	141	147
1.0	34.5	37.9	41.6	46.3	48.8
10	4.8	5.3	5.8	6.6	7.0
20	3.0	3.3	3.6	4.1	4.3
100	1.3	1.4	1.5	1.7	1.8

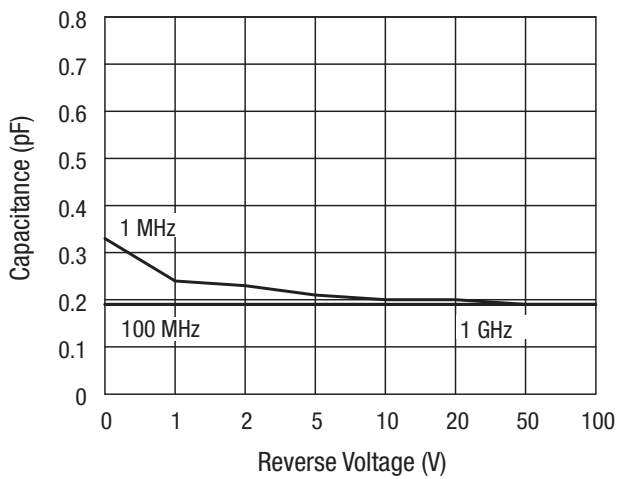
### Typical Performance Characteristics



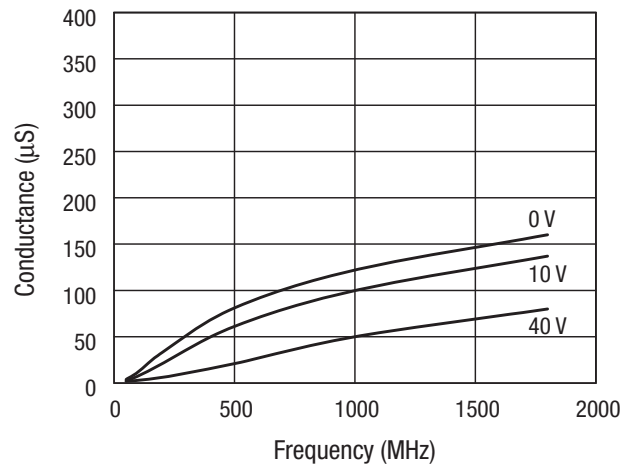
**Figure 3. Series Resistance vs Current @ 100 MHz**



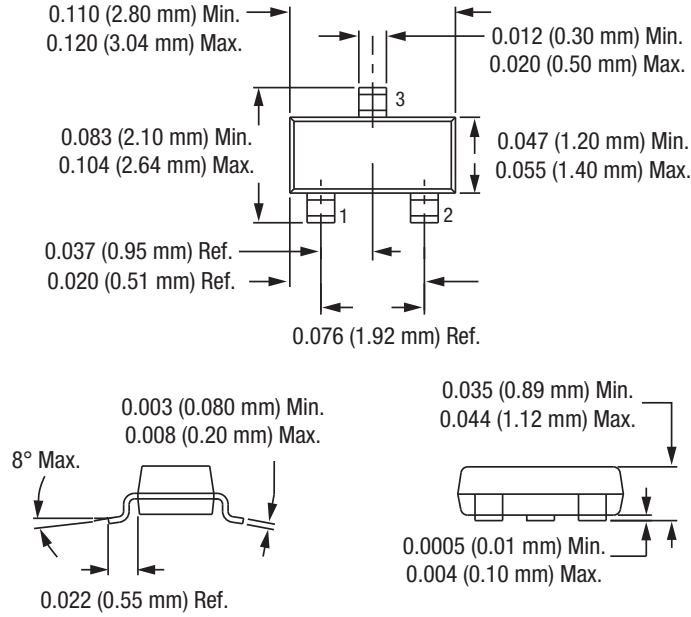
**Figure 4. DC Characteristic**



**Figure 5. Capacitance vs Reverse Voltage**



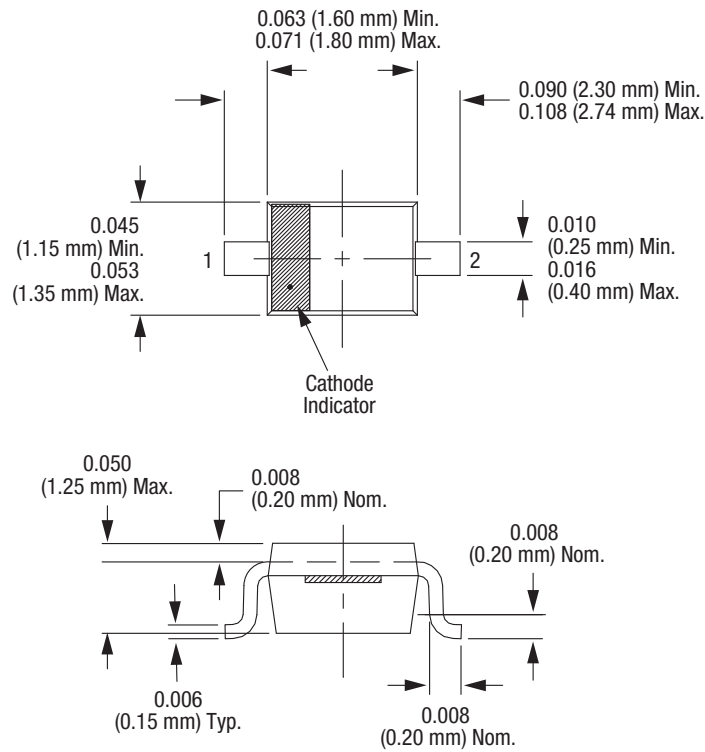
**Figure 6. Conductance vs Frequency and Reverse Voltage**



Dimensions are in inches (millimeters shown in parentheses)

S1389

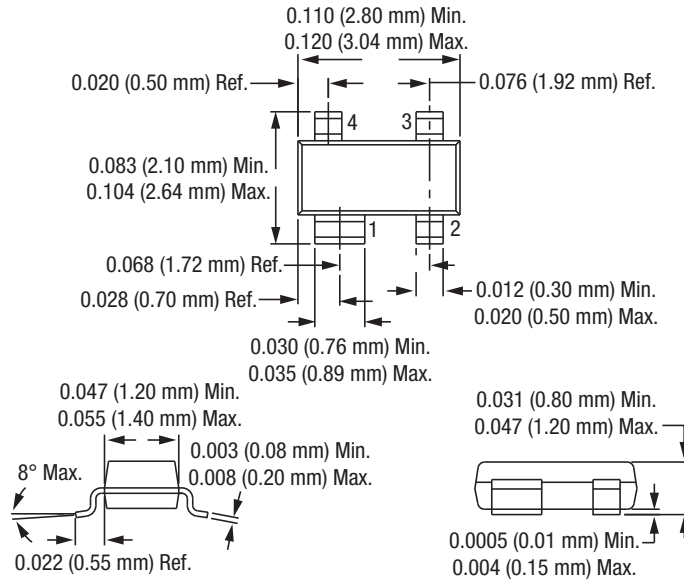
Figure 7. SOT-23 Package Dimension Drawing



Dimensions are in inches (millimeters shown in parentheses)

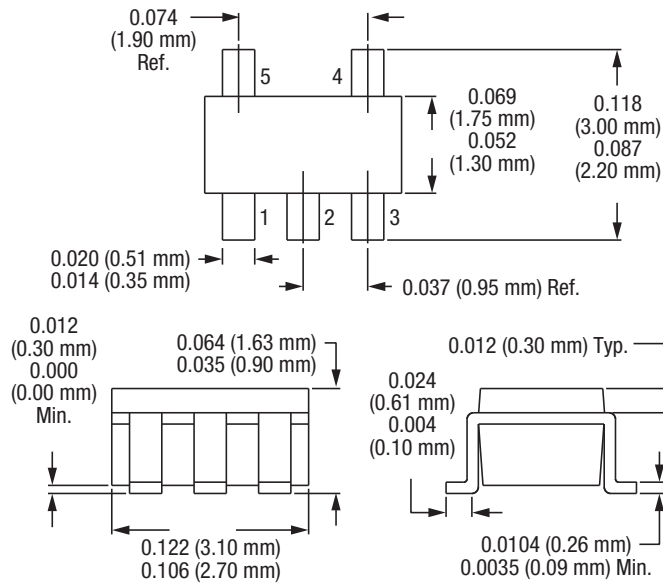
S1619

Figure 8. SOD-323 Package Dimension Drawing



Dimensions are in inches (millimeters shown in parentheses) **S1651**

**Figure 9. SOT-143 Package Dimension Drawing**



Dimensions are in inches (millimeters shown in parentheses) **S1657**

**Figure 10. SOT-5 Package Dimension Drawing**

Copyright © 2002-2007, 2009, 2010 Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products or services. These materials, including the information contained herein, are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials or the information contained herein. Skyworks may change its documentation, products, services, specifications or product descriptions at any time, without notice. Skyworks makes no commitment to update the materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

No license, whether express, implied, by estoppel or otherwise, is granted to any intellectual property rights by this document. Skyworks assumes no liability for any materials, products or information provided hereunder, including the sale, distribution, reproduction or use of Skyworks products, information or materials, except as may be provided in Skyworks Terms and Conditions of Sale.

THE MATERIALS, PRODUCTS AND INFORMATION ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. SKYWORKS DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications, or other equipment in which the failure of the Skyworks products could lead to personal injury, death, physical or environmental damage. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

Customers are responsible for their products and applications using Skyworks products, which may deviate from published specifications as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Skyworks assumes no liability for applications assistance, customer product design, or damage to any equipment resulting from the use of Skyworks products outside of stated published specifications or parameters.

Skyworks, the Skyworks symbol, and "Breakthrough Simplicity" are trademarks or registered trademarks of Skyworks Solutions, Inc., in the United States and other countries. Third-party brands and names are for identification purposes only, and are the property of their respective owners. Additional information, including relevant terms and conditions, posted at [www.skyworksinc.com](http://www.skyworksinc.com), are incorporated by reference.