# SMP1322 Series: Low Resistance, Plastic Packaged PIN Diodes

## Applications

- High-performance wireless switch applications

## Features

- Resistance: 0.8 Ω typical @ 1 mA
- Packages rated MSL1, 260 °C per JEDEC J-STD-020)

Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™,* document number SQ04-0074.

## Description

The SMP1322 series of plastic packaged, surface mountable PIN diodes is designed for use in high volume switch applications from 10 MHz to more than 10 GHz. The ultra-low resistance of these diodes (1.5 Ω maximum at 1 mA and 0.5 Ω typical at 10 mA) makes the SMP1322 series particularly suited to low-loss PIN diode switches in battery operated circuits.

The SMP1322 series is available in a selection of plastic packages and a variety of configurations that include an SC-70, a small footprint SC-79, SOD-323, and a miniature SOD-882.

The SMP1322-016 consists of two diodes in an SOT-143 package configured to enable insertion in a quarter-wave transmit/receive (T/R) switch with no crossover connections.

Table 1 describes the various packages and marking of the SMP1322 series.

**Table 1. SMP1322 Series Packaging and Marking**

| Single | Common Anode | Common Cathode | Series Pair | Single | T/R Switch | Single | Single |
|---|---|---|---|---|---|---|---|
| SOT-23 | SOT-23 | SOT-23 | SOT-23 | SOD-323 Green™ | SOT-143 | SC-79 Green™ | SOD-882 Green™ |
| **SMP1322-001** Marking: PN1 | **SMP1322-003** Marking: PN9 | **SMP1322-004** Marking: PN3 | **SMP1322-005** Marking: PN2 | | **SMP1322-016** Marking: PN6 | | |
| **SMP1322-001LF** Green™ Marking: RN1 | **SMP1322-003LF** Green™ Marking: RN9 | **SMP1322-004LF** Green™ Marking: RN3 | **SMP1322-005LF** Green™ Marking: RN2 | **SMP1322-011LF** Marking: RN | **SMP1322-016LF** Marking: RN6 | **SMP1322-079LF** Marking: Cathode | **SMP1322-040LF** Marking: T |
| $L_S$ = 1.5 nH | $L_S$ = 1.5 nH | $L_S$ = 1.5 nH | $L_S$ = 1.5 nH | $L_S$ = 1.5 nH | $L_S$ = 1.5 nH | $L_S$ = 0.7 nH | $L_S$ = 0.45 nH |
| | | | SC-70 | | | | |
| | | | | | | | |
| | | | **SMP1322-075LF** Green™ Marking: RN2 | | | | |
| | | | $L_S$ = 1.4 nH | | | | |

The Pb-free symbol or "LF" in the part number denotes a lead-free, RoHS-compliant package unless otherwise noted as Green™. Tin/lead (Sn/Pb) packaging is not recommended for new designs.
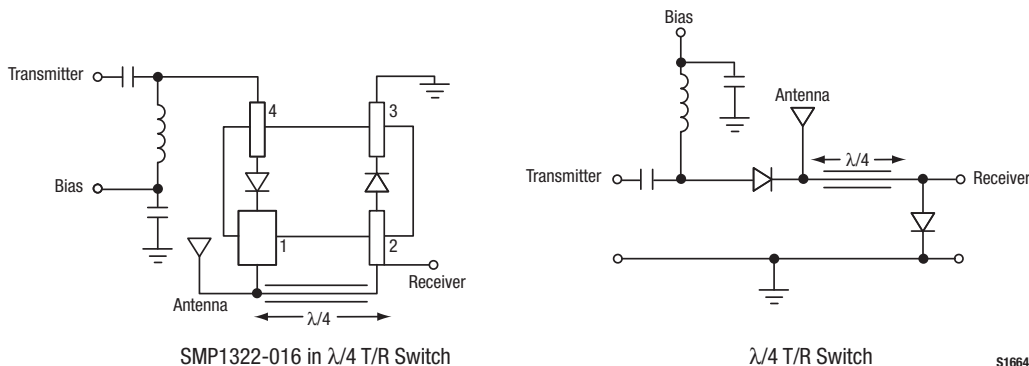


SMP1322-016 in λ/4 T/R Switch     λ/4 T/R Switch     S1664

**Figure 1. SMP1322-016 Quarter-Wave T/R Switch**

## SMP1322-016 T/R Switch

The SMP1322-016 is a low-cost PIN diode unconnected pair specifically designed for low-current drain antenna T/R switches in hand-held wireless systems. In the specifically configured SOT-143 package (see Figure 1), the PIN diodes are oriented to enable connection as a λ/4 switch with no external crossover connections.

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SMP1322 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 SMP1322 series are illustrated in Figures 2 to 6. Package dimensions are shown in Figures 7 to 17 (odd numbers), and tape and reel dimensions are provided in Figures 8 to 18 (even numbers).

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**Table 2. SMP1322 Series Absolute Maximum Ratings**

| Parameter | Symbol | Minimum | Maximum | Units |
|---|---|---|---|---|
| Reverse voltage | $V_R$ | | 50 | 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 |
| Electrostatic discharge:<br><br>Charged Device Model (CDM), Class 4<br>Human Body Model (HBM), Class 1B | ESD | | <br><br>1000<br>1000 | <br><br>V<br>V |

**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.

**Table 3. SMP1322 Series Electrical Specifications (Note 1)**
**($T_A$ = +25 °C, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Reverse current | $I_R$ | $V_R$ = 50 V | | | 10 | μA |
| Capacitance (Note 2) | $C_T$ | F = 1 MHz, V = 30 V | | | 1 | pF |
| Resistance | $R_S$ | F = 100 MHz<br><br>I = 1 mA<br>I = 10 mA | | <br><br><br>0.5 | <br><br>1.5 | <br><br>Ω<br>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 |

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

**Note 2:** $C_T$ is 1.15 pF maximum for the SMP1322-016.

*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.*

## 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 SMP1322 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.

**Table 4. Resistance vs Temperature @ 500 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 | 9.5 | 9.4 | 9.9 | 10.5 | 10.9 |
| 0.10 | 3.0 | 3.0 | 3.0 | 3.3 | 3.5 |
| 0.30 | 1.5 | 1.5 | 1.5 | 1.6 | 1.8 |
| 0.50 | 1.1 | 1.1 | 1.2 | 1.2 | 1.4 |
| 1.0 | 0.922 | 0.914 | 0.902 | 0.963 | 1.100 |
| 10 | 0.568 | 0.559 | 0.533 | 0.563 | 0.655 |
| 20 | 0.532 | 0.520 | 0.494 | 0.521 | 0.610 |
| 100 | 0.483 | 0.469 | 0.440 | 0.464 | 0.565 |

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## Typical Performance Characteristics
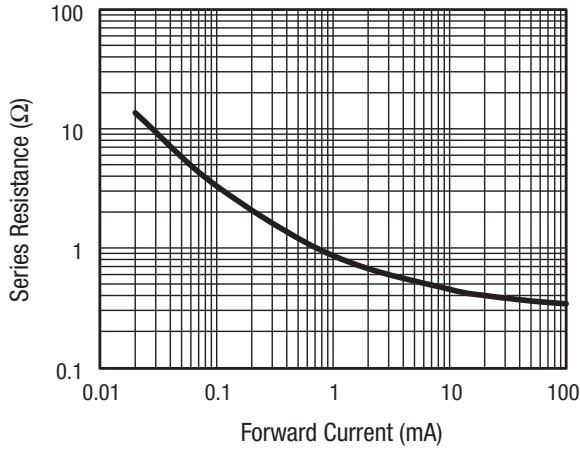
Figure 2. Series Resistance vs Current @ 100 MHz
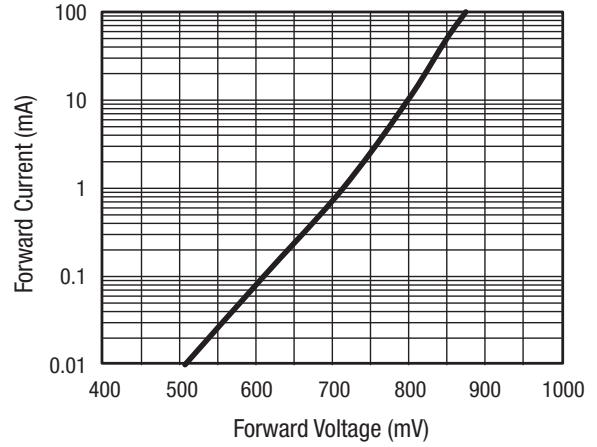
Figure 3. DC Characteristics
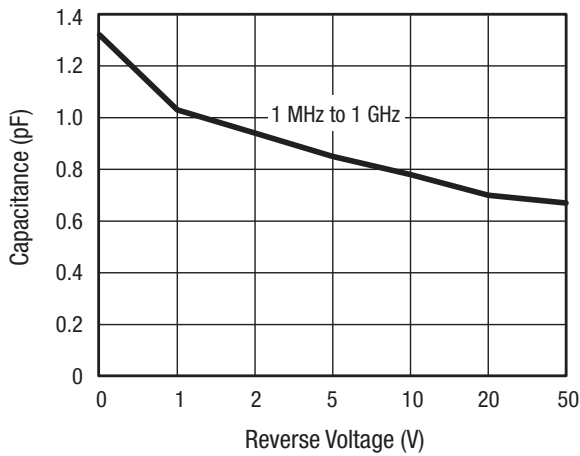
Figure 4. Capacitance vs Reverse Voltage
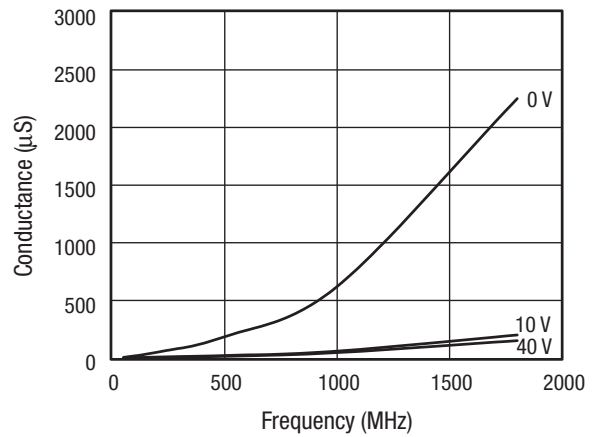
Figure 5. Conductance vs Frequency and Reverse Voltage
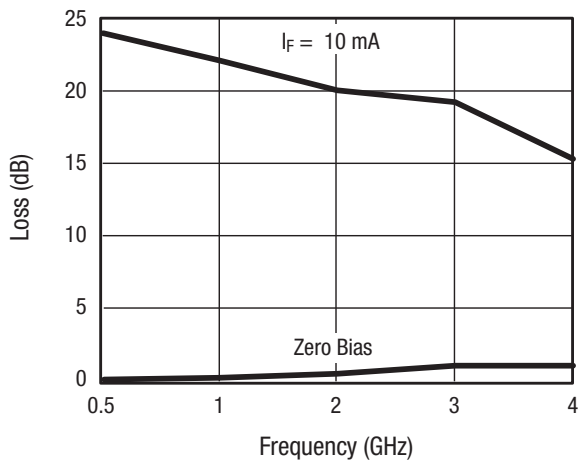
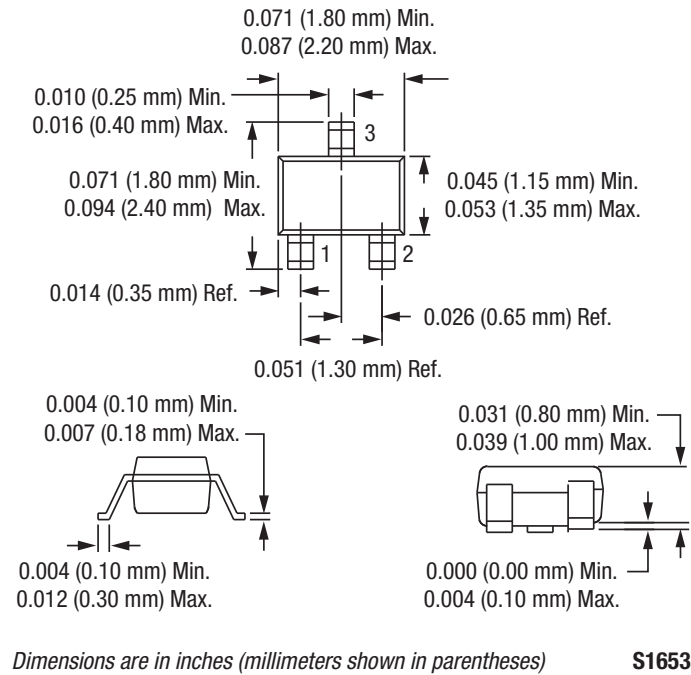Figure 6. SMP1322-017 Typical SPST Switch Performance

0.071 (1.80 mm) Min.
0.087 (2.20 mm) Max.
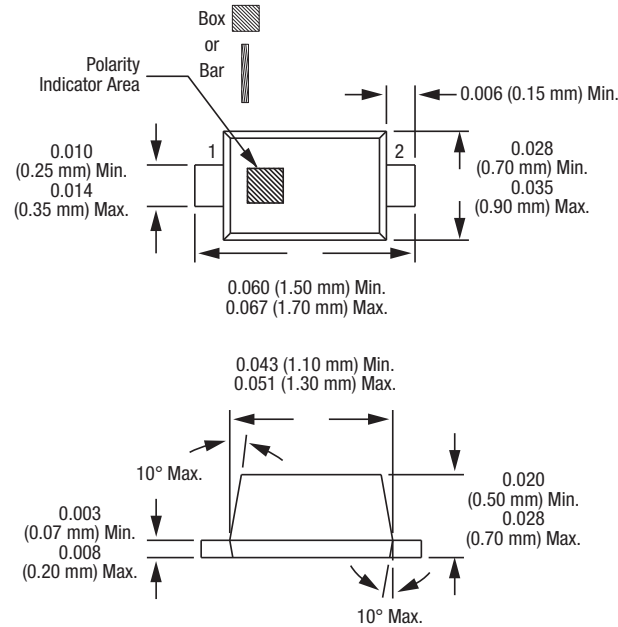
0.010 (0.25 mm) Min.
0.016 (0.40 mm) Max.

3

0.071 (1.80 mm) Min.
0.094 (2.40 mm)  Max.

0.045 (1.15 mm) Min.
0.053 (1.35 mm) Max.

1    2

0.014 (0.35 mm) Ref.

0.026 (0.65 mm) Ref.

0.051 (1.30 mm) Ref.

0.004 (0.10 mm) Min.
0.007 (0.18 mm) Max.

0.031 (0.80 mm) Min.
0.039 (1.00 mm) Max.

0.004 (0.10 mm) Min.
0.012 (0.30 mm) Max.

0.000 (0.00 mm) Min.
0.004 (0.10 mm) Max.

*Dimensions are in inches (millimeters shown in parentheses)*     **S1653**

**Figure 7. SC-70 Package Dimension Drawing**

4.00

2.00 ± 0.05
(See Note 3)

4.00
(See Note 1)

∅0.76 Min.

∅1.50 +0.1/–0

A

1.75 ± 0.10

T ± 0.05

2.00

3.50 ± 0.05
(See Note 3)

8.00 +0.3/–0.1

R 0.20 Max.

1.19 (Ko)

2.50 (Bo)

2.25 (Ao)

1.00

A

Pin 1

R 0.3 Typ.

0.59

A
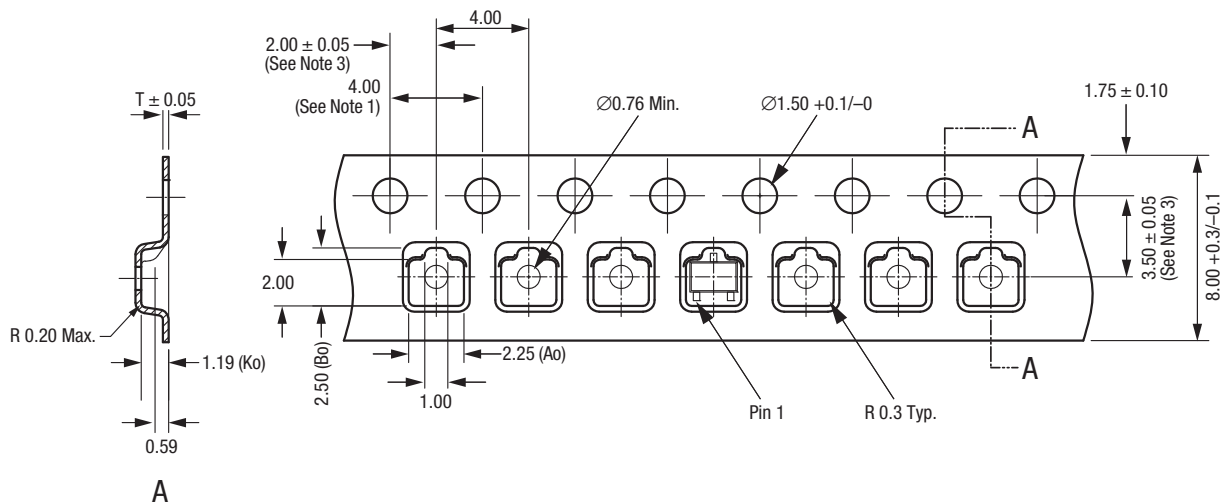
*Notes:*
 *1. Sprocket hole pitch cumulative tolerance ±0.2.*
 *2. Carrier tape: black conductive polystyrene.*
 *3. Pocket position relative to sprocket hole measured*
 *   as true position of pocket, not pocket hole.*
 *4. Cover tape material: transparent conductive PSA with 9.2 mm width.*
 *5. All measurements are in millimeters.*

**S1685c**

**Figure 8. SC-70 Tape and Reel Dimensions**

Box

or

Bar

Polarity
Indicator Area

0.006 (0.15 mm) Min.

1

2

0.010
(0.25 mm) Min.
0.014
(0.35 mm) Max.

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.

0.020
(0.50 mm) Min.
0.028
(0.70 mm) Max.

0.003
(0.07 mm) Min.
0.008
(0.20 mm) Max.

10° Max.

*Dimensions are in inches (millimeters shown in parentheses)*          **S1652**

**Figure 9. SC-79 Package Dimension Drawing**

Ø1.50± 0.10

4.00 ± 0.10

4.00 ± 0.10

2.00 ± 0.05

1.75 ± 0.10

0.229 ± 0.02 (T)

B

2° Max

1.95 ± 0.05 (Bo)

1.40 ± 0.05

A

A

3.50 ± 0.05

8.00 ± 0.20

B

0.80 ± 0.05 (Ko)

Pin 1 Indicator

Ø0.50± 0.05
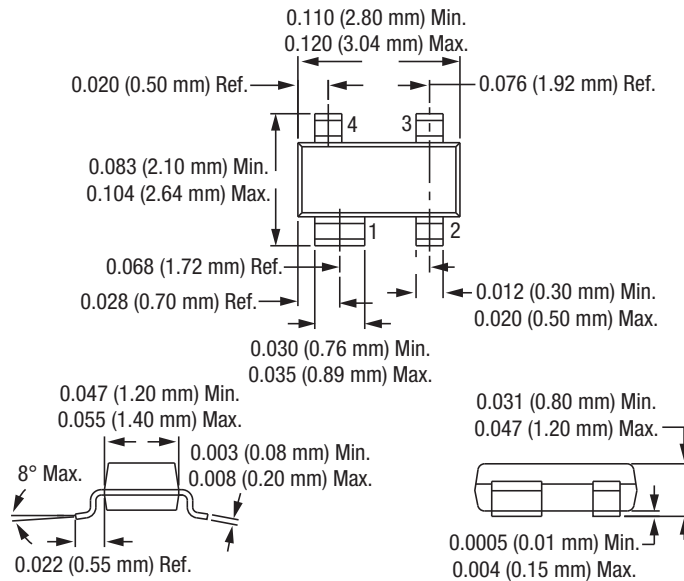
B

0.39 ± 0.05

2° Max

0.90 ± 0.05 (Ao)

A
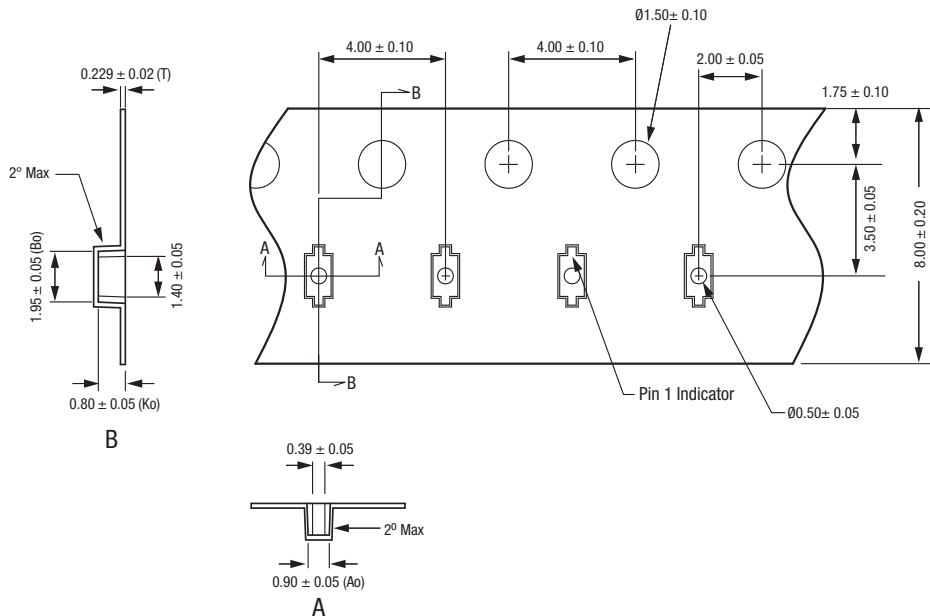
*Notes:*
 *1. Carrier tape: black conductive polycarbonate or polystyrene.*
 *2. Cover tape material: transparent conductive PSA.*
 *3. Cover tape size: 5.4 mm width.*
 *4. ESD-surface resistivity is ≤1 x 10$^8$ Ohms/square per*
 *   EIA, JEDEC TNR Specification.*
 *4. All measurements are in millimeters.*

**S2929**

**Figure 10. SC-79 Tape and Reel Dimensions**

0.060 (1.52 mm) Min.
0.070 (1.78 mm) Max.

0.090 (2.29 mm) Min.
0.107 (2.72 mm) Max.

0.000 (0 mm) Min.
0.004 (0.10 mm) Max.

0.044 (1.12 mm) Min.
0.054 (1.37 mm) Max.

1       2

0.013 (0.33 mm) Min.
0.017 (0.43 mm) Max.

0.012 (0.305 mm) Min.
0.016 (0.406 mm) Max.

0.036 (0.91 mm) Min.
0.046 (1.17 mm) Max.

Cathode Indicator

0.025 (0.635 mm) Min.
0.037 (0.940 mm) Max.

0.008 Ref.

Gauge Datum
For Foot Length
Measurement

0.005 (0.127 mm) Min.
0.008 (0.203 mm) Max.

0.010 (0.25 mm) Min.
0.018 (0.46 mm) Max.
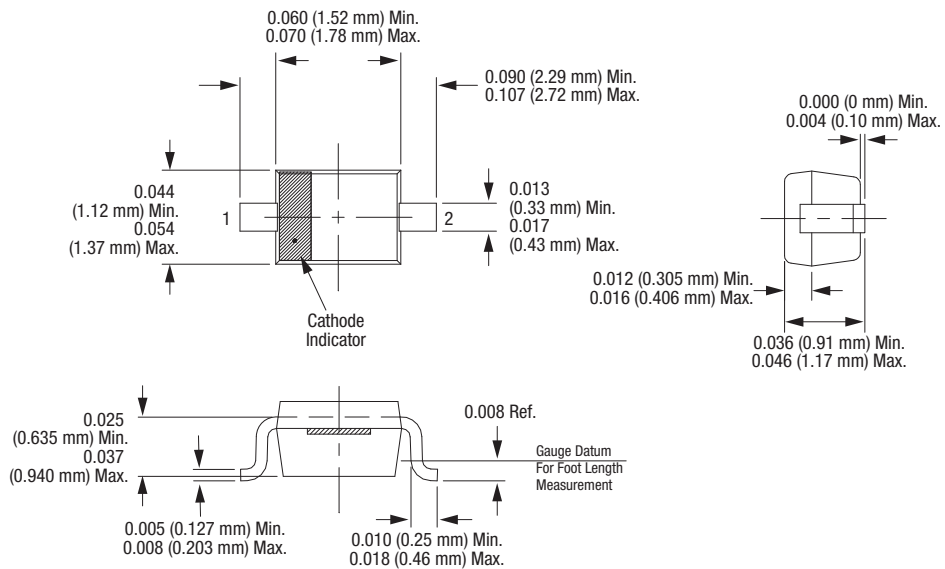
*Dimensions are in inches (millimeters shown in parentheses)*

S1619

**Figure 11. SOD-323 Package Dimension Drawing**

4.00

2.00 ± 0.05

0.30 ± 0.05

Ø1.50 +0.1/–0

Ø1.00 Min.

Pin 1
Indicator

1.75 ± 0.10

R0.3 Max.

4.00
(See Note 4)

2.90 (Bo)

2.08

3.50 ± 0.05

8.00 +0.30/–0.10

1.35 (Ko)

1.07 (K1)

A

1.52 (Ao)

R0.5 Typ.

0.84

A
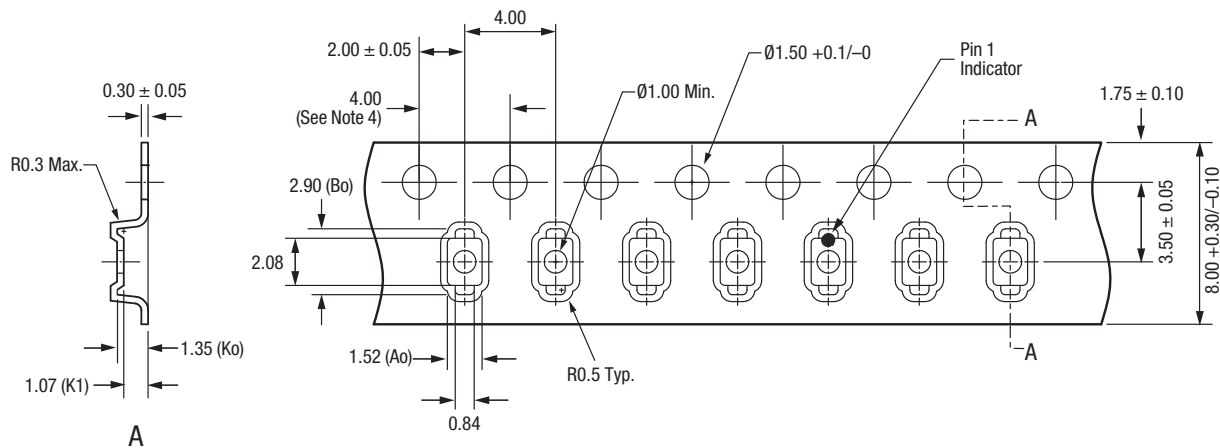
*Notes:*
1. *Carrier tape: black conductive polystyrene.*
2. *Cover tape: transparent conductive PSA.*
3. *Cover tape size: 5.4 mm width.*
4. *10 sprocket hole pitch cumulative tolerance: ±0.20 mm.*
5. *All measurements are in millimeters.*

S2910

**Figure 12. SOD-323 Tape and Reel Dimensions**

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0.110 (2.80 mm) Min.
0.120 (3.04 mm) Max.

0.012 (0.30 mm) Min.
0.020 (0.50 mm) Max.

0.083 (2.10 mm) Min.
0.104 (2.64 mm) Max.

0.047 (1.20 mm) Min.
0.055 (1.40 mm) Max.

0.037 (0.95 mm) Ref.
0.020 (0.51 mm) Ref.

0.076 (1.92 mm) Ref.

0.003 (0.080 mm) Min.
0.008 (0.20 mm) Max.

0.035 (0.89 mm) Min.
0.044 (1.12 mm) Max.

8° Max.

0.0005 (0.01 mm) Min.
0.004 (0.10 mm) Max.

0.022 (0.55 mm) Ref.

*Dimensions are in inches (millimeters shown in parentheses)*  **S1389**

**Figure 13. SOT-23 Package Dimension Drawing**
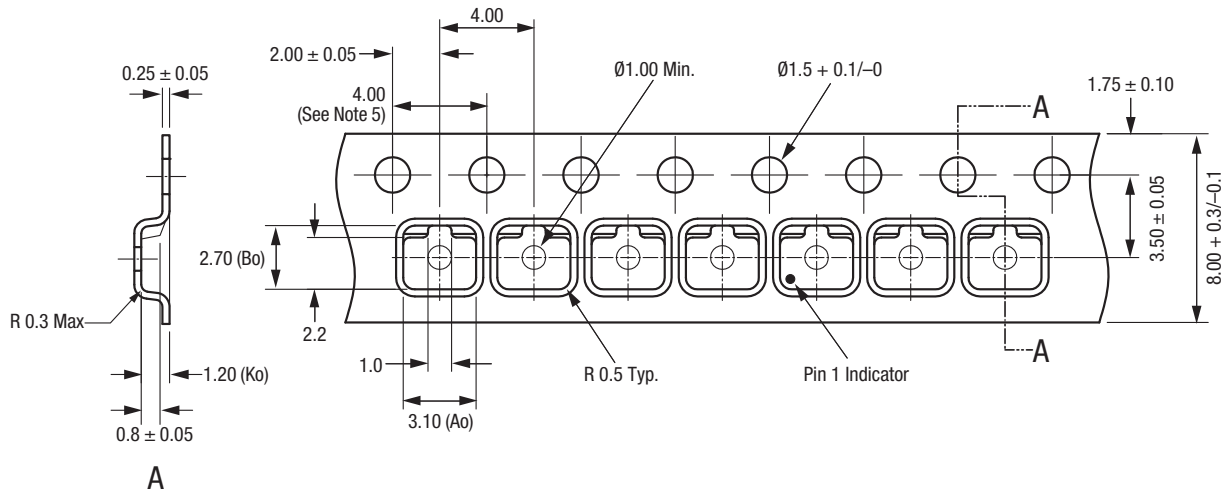


0.25 ± 0.05
2.00 ± 0.05
4.00
4.00 (See Note 5)
Ø1.00 Min.
Ø1.5 + 0.1/–0
1.75 ± 0.10
A
2.70 (Bo)
3.50 ± 0.05
8.00 + 0.3/–0.1
R 0.3 Max
2.2
1.0
R 0.5 Typ.
Pin 1 Indicator
A
1.20 (Ko)
0.8 ± 0.05
3.10 (Ao)
A

Notes:
1. Carrier tape: black conductive polycarbonate.
2. Cover tape material: transparent conductive PSA.
3. Cover tape size: 5.40 mm width.
4. Tolerance ±0.10 mm.
5. Ten sprocket hole pitch cumulative tolerance: ±0.2 mm.
6. All measurements are in millimeters.

**S1684b**

**Figure 14. SOT-23 Tape and Reel Dimensions**

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

**Figure 15. SOT-143 Package Dimension Drawing**
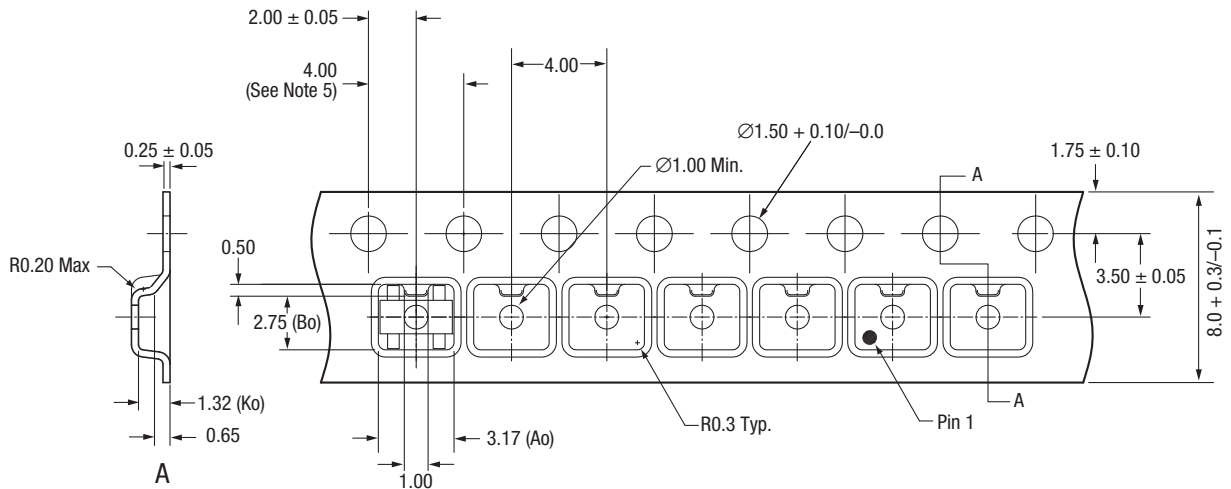


*Notes:*
*1. Carrier tape: black conductive polycarbonate.*
*2. Cover tape material: transparent conductive PSA.*
*3. Cover tape size: 5.4 mm width.*
*4. Tolerance: .XX = ±0.10*
*5. Ten sprocket hole pitch cumulative tolerance: ±0.2 mm.*
*6. All measurements are in millimeters.*

**S2515a**

**Figure 16. SOT-143 Tape and Reel Dimensions**

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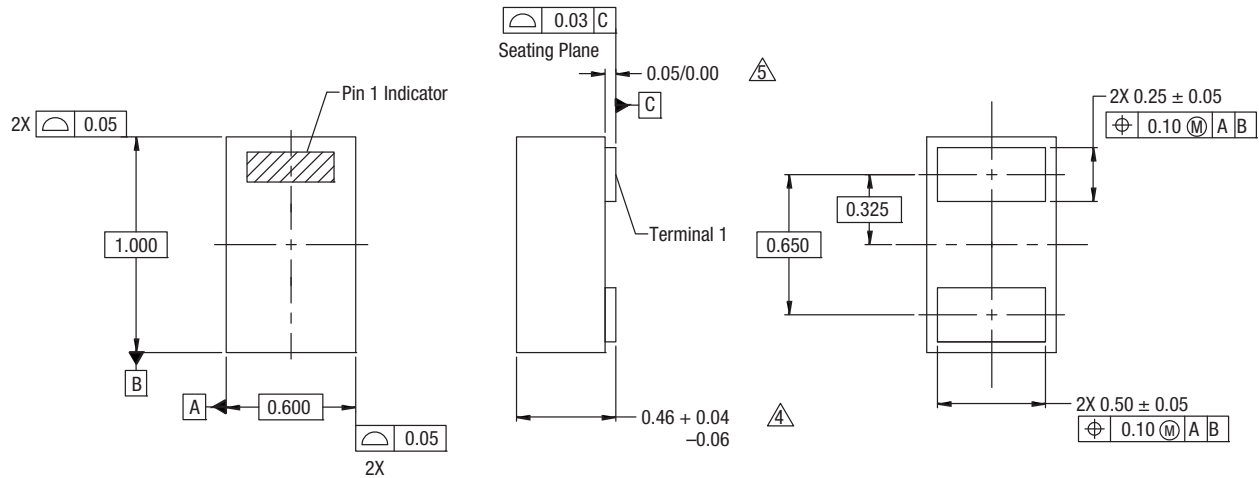
NOTES:
1. All measurements are in millimeters.
2. Dimensions and tolerances according to ASME Y14.5M-1994.
3. These packages are used principally for discrete devices.
4. This dimension includes stand-off height and package body thickness,
   but does not include attached features, e.g., external heatsink or chip capacitors.
   An integral heatslug is not considered an attached feature.
5. This dimension is primarily terminal plating, but does not include small metal protrusion.

Y1410

**Figure 17. SOD-882 Package Dimension Drawing**
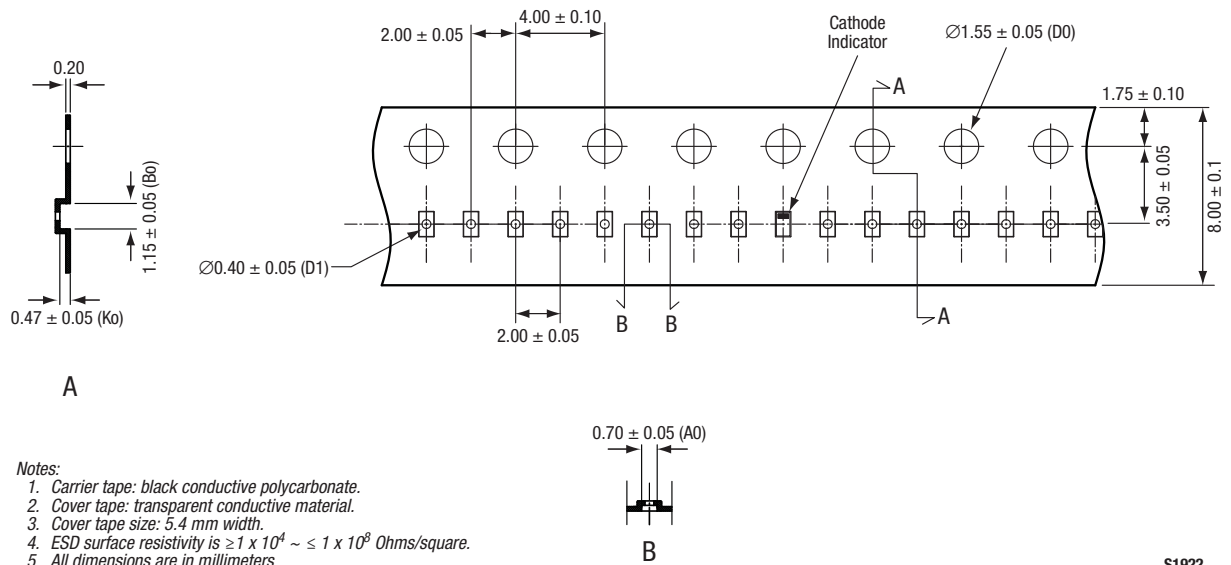


Notes:
1. Carrier tape: black conductive polycarbonate.
2. Cover tape: transparent conductive material.
3. Cover tape size: 5.4 mm width.
4. ESD surface resistivity is $\geq 1 \times 10^4 \sim \leq 1 \times 10^8$ Ohms/square.
5. All dimensions are in millimeters.

S1922

**Figure 18. SOD-882 Tape and Reel Dimensions**

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