

# 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



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## 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 μm 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 μs typical carrier lifetime of these diodes results in a resistance of 20 Ω maximum at 1 mA and 7 Ω maximum at 10 mA.

The SMP1304 series is available in a selection of plastic packages: as a single diode in small footprint SOD-323 and SC-79 packages, 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                                      | Single                            |
| SOT-23                                  | SOT-23                                  | SOT-23                                  | SOT-23                                  | SOT-23                                  | SOD-323 Green™                 | SOT-143                       | SOT-5                                   | SC-79 Green™                      |
| SMP1304-001<br>Marking: PG1             | SMP1304-004<br>Marking: PG3             | SMP1304-005<br>Marking: PG2             |   | SMP1304-007<br>Marking: PGB             |                                | SMP1304-019<br>Marking: PGJ   | SMP1304-027<br>Marking: PGM             |                                   |
| SMP1304-001LF<br>Green™<br>Marking: RG1 | SMP1304-004LF<br>Green™<br>Marking: RG3 | SMP1304-005LF<br>Green™<br>Marking: RG2 | SMP1304-006LF<br>Green™<br>Marking: RG8 | SMP1304-007LF<br>Green™<br>Marking: RGB | ◆ SMP1304-011LF<br>Marking: RG | SMP1304-019LF<br>Marking: RGJ | SMP1304-027LF<br>Green™<br>Marking: RGM | SMP1304-079LF<br>Marking: Cathode |
| Ls = 1.5 nH                             | Ls = 1.5 nH                             | Ls = 1.5 nH                             | Ls = 1.5 nH                             | Ls = 1.4 nH                             | Ls = 1.5 nH                    | Ls = 1.5 nH                   | Ls = 1.5 nH                             | Ls = 0.7 nH                       |

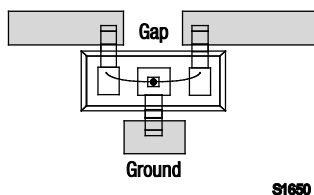
The Pb-free symbol or "LF" in the part number denotes a lead-free, RoHS-compliant package unless otherwise noted as Green™. Tin/lead (Sn/Pb) packaging is not recommended for new designs.

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### 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 15 (odd numbers), and tape and reel dimensions are provided in Figures 8 to 16 (even numbers).

### 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.

**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           | $R_S$    | $f = 100\text{ MHz}$<br>$I = 1\text{ mA}$<br>$I = 10\text{ mA}$<br>$I = 100\text{ mA}$ | 40      | 50<br>7<br>2 | $\Omega$<br>$\Omega$<br>$\Omega$ |
| Forward voltage      | $V_F$    | $I_F = 10\text{ mA}$   | 0.8     |              | V                                |
| Carrier lifetime     | $\tau_I$ | $I_F = 10\text{ mA}$   | 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**

| $I_F$<br>(mA) | $R_S @ -55\text{ °C}$<br>( $\Omega$ ) | $R_S @ -15\text{ °C}$<br>( $\Omega$ ) | $R_S @ +25\text{ °C}$<br>( $\Omega$ ) | $R_S @ +65\text{ °C}$<br>( $\Omega$ ) | $R_S @ +100\text{ °C}$<br>( $\Omega$ ) |
|---------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|--|
| 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

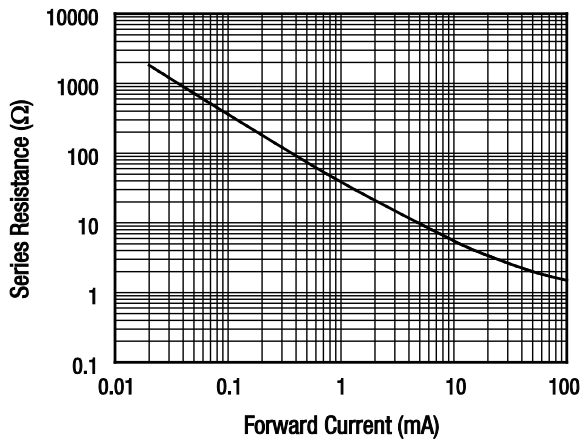


Figure 3. Series Resistance vs Current @ 100 MHz

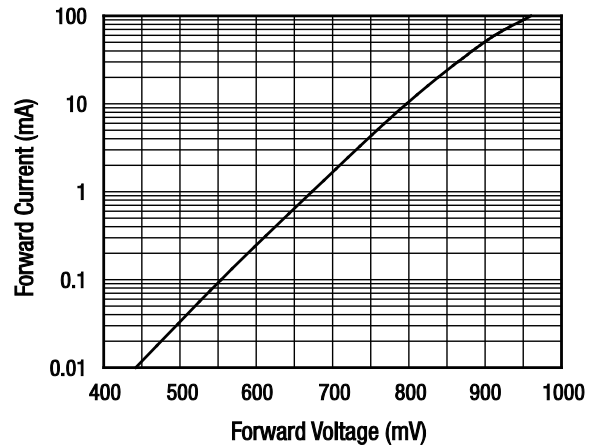


Figure 4. DC Characteristic

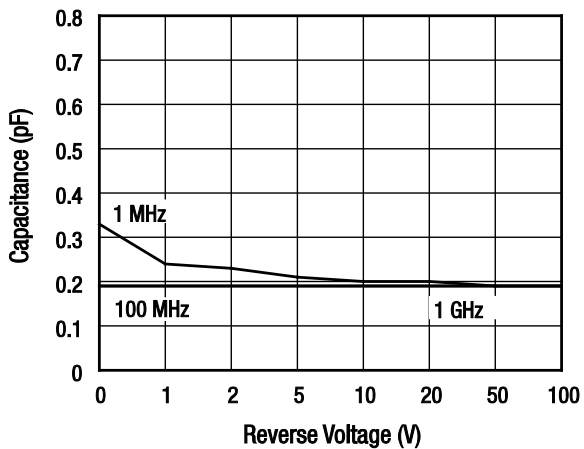


Figure 5. Capacitance vs Reverse Voltage

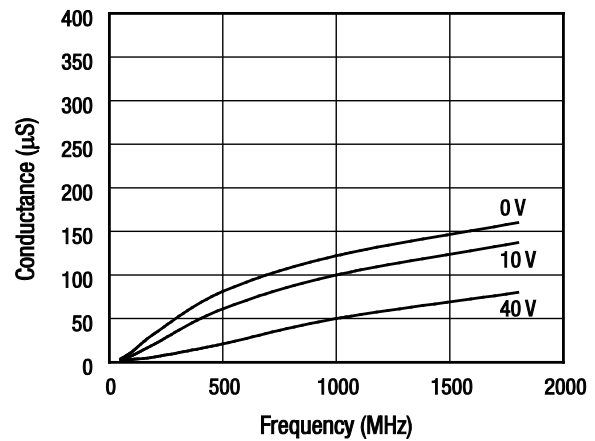
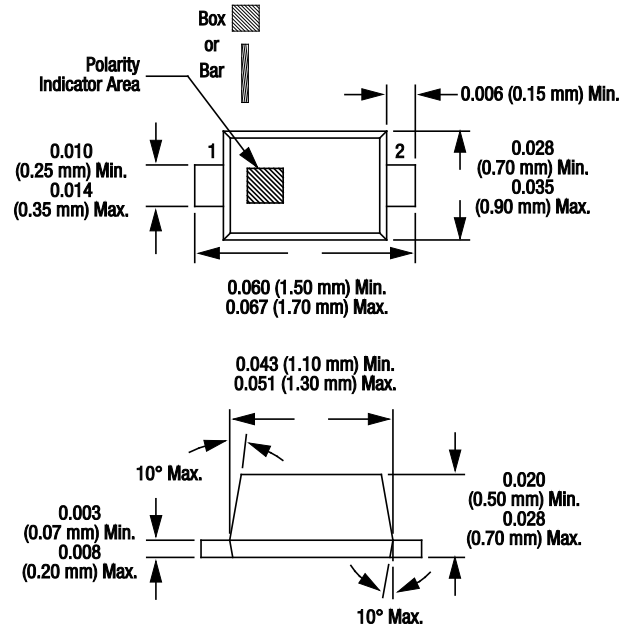
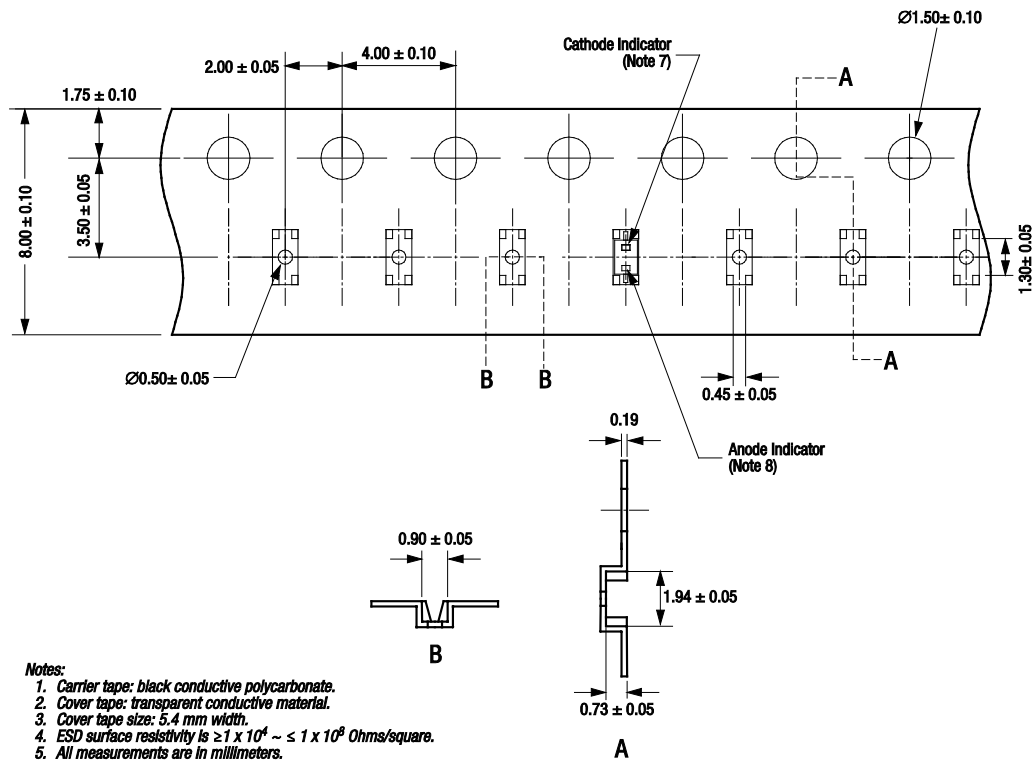


Figure 6. Conductance vs Frequency and Reverse Voltage



Dimensions are in inches (millimeters shown in parentheses) S1652

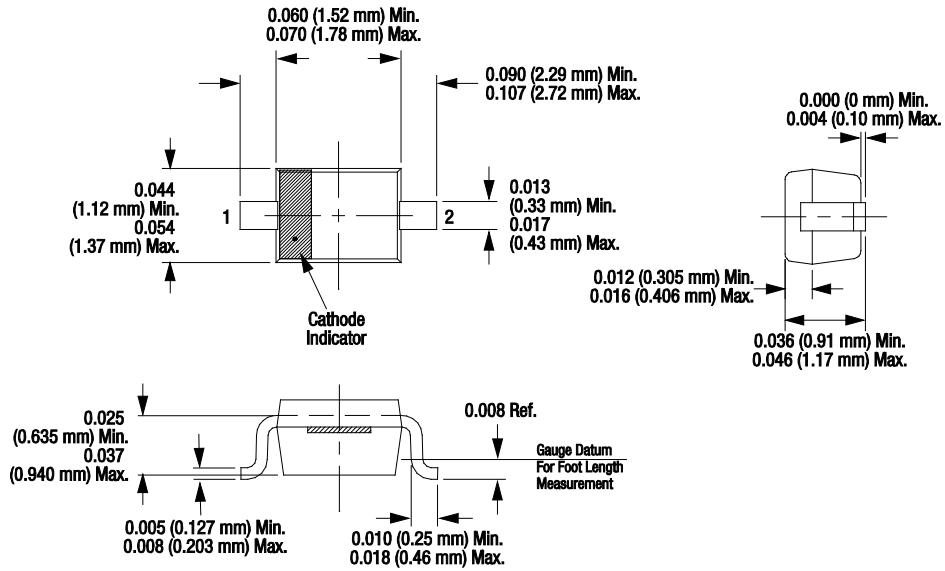
Figure 7. SC-79 Package Dimension Drawing



- 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  $\geq 1 \times 10^4 \sim \leq 1 \times 10^6$  Ohms/square.
  5. All measurements are in millimeters.
  6. Standard reel size is 7 inches. Standard reel quantity is 3000 pcs.
  7. Cathode indicator for all devices except for the SMS7630-079LF.
  8. Anode indicator for the SMS7630-079LF only.

S2188

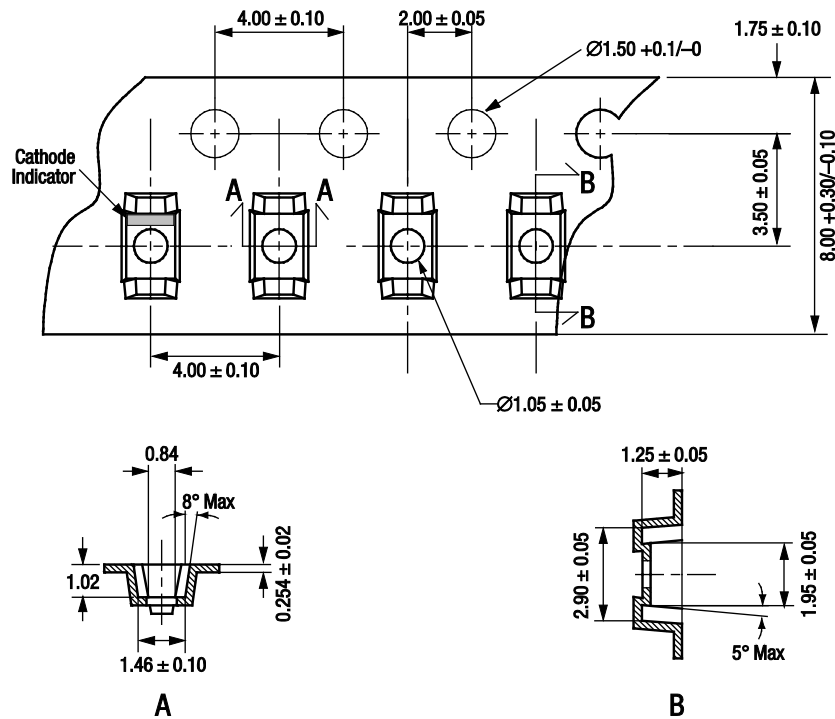
Figure 8. SC-79 Tape and Reel Dimensions



Dimensions are in inches (millimeters shown in parentheses)

S1619

Figure 9. SOD-323 Package Dimension Drawing

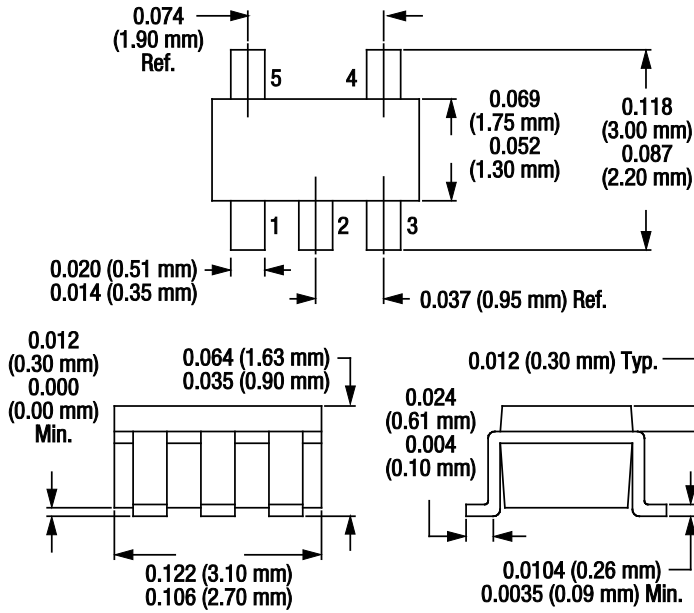


Notes:

1. Carrier tape: black conductive polycarbonate or polystyrene.
2. Cover tape: transparent conductive material.
3. Cover tape size: 5.5 mm width.
4. ESD surface resistivity is  $\geq 1 \times 10^6 \sim \leq 1 \times 10^{11}$  Ohms/square.
5. 10 sprocket hole pitch cumulative tolerance:  $\pm 0.20$  mm.
6. A<sub>o</sub> and B<sub>o</sub> measured on plane 0.30 mm above bottom of the pocket.
7. All measurements are in millimeters.
8. Standard reel size is 7 inches. Standard reel quantity is 3000 pcs.

S2061

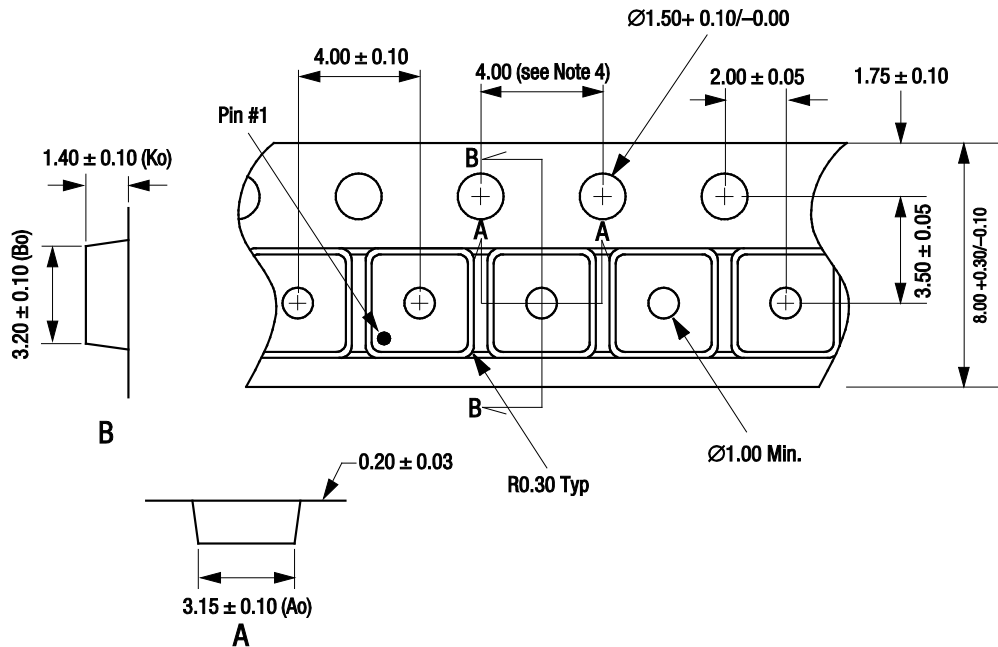
Figure 10. SOD-323 Tape and Reel Dimensions



Dimensions are in inches (millimeters shown in parentheses)

S1657

Figure 11. SOT-5 Package Dimension Drawing

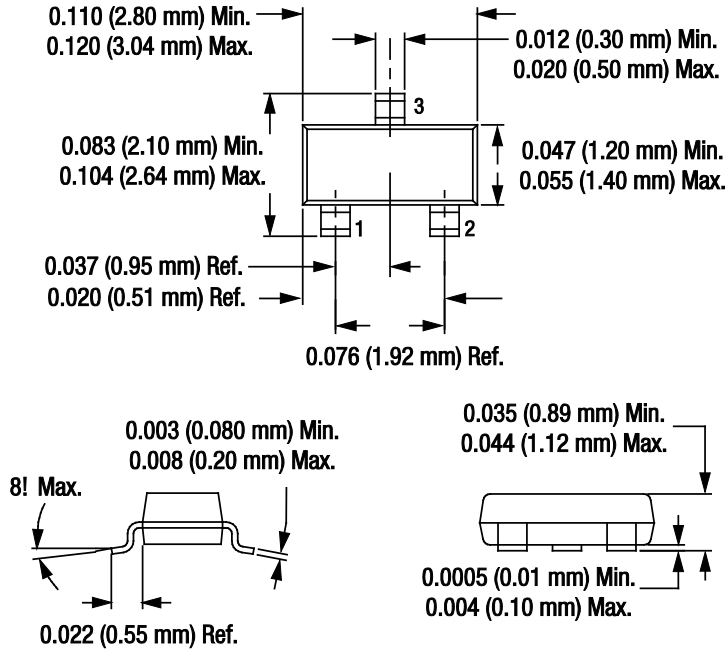


Notes:

1. Carrier tape: black conductive polystyrene.
2. Cover tape material: transparent conductive HSA.
3. Cover tape size: 5.40 mm width.
4. Ten sprocket hole pitch cumulative tolerance = ±0.20 mm.
5. All measurements are in millimeters.
6. Standard reel size is 7 inches. Standard reel quantity is 3000 pcs.

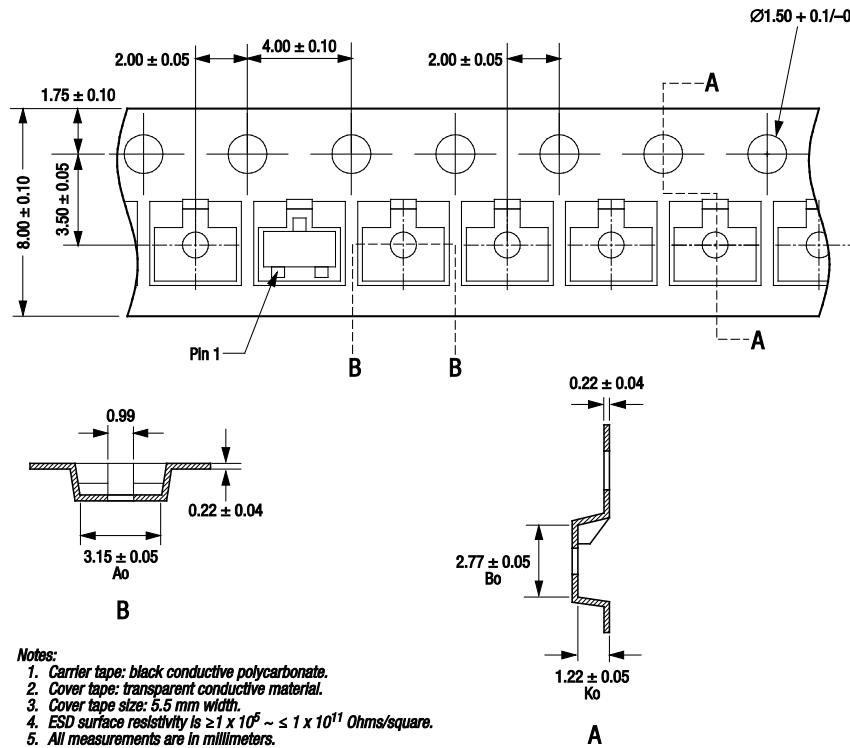
S1681

Figure 12. SOT-5 Tape and Reel Dimensions



Dimensions are in inches (millimeters shown in parentheses) S1389

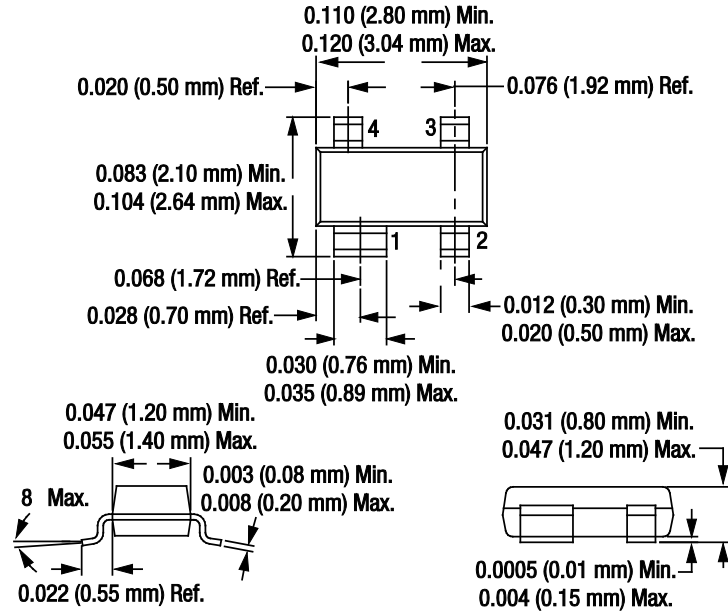
**Figure 13. SOT-23 Package Dimension Drawing**



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

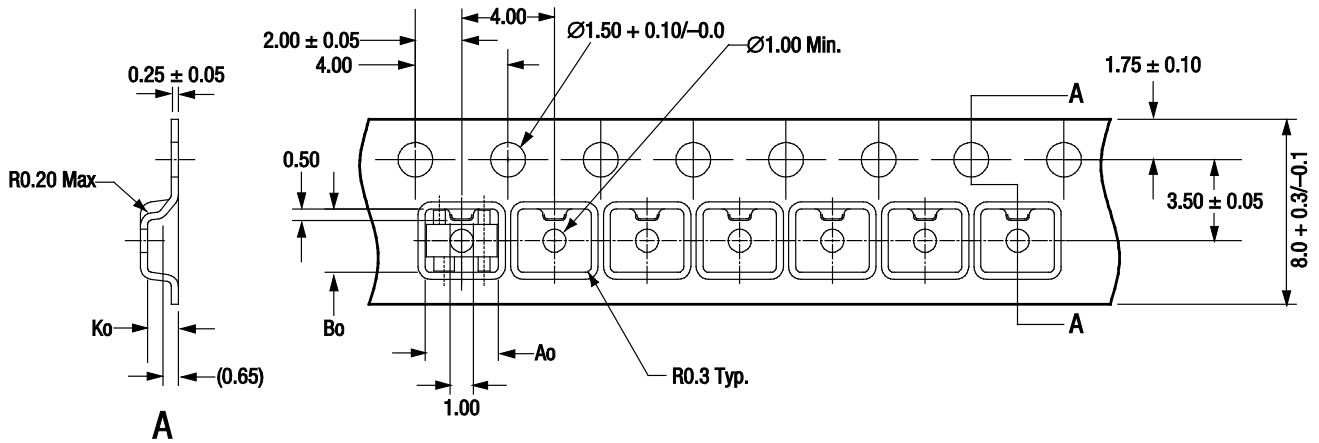
S2259





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

Figure 15. SOT-143 Package Dimension Drawing



Ao = 3.17  
Bo = 2.75  
Ko = 1.32

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. All measurements are in millimeters.

**S2515**

Figure 16. SOT-143 Tape and Reel Dimensions

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