

DATA SHEET

# SMV2019-SMV2023 Series: Hyperabrupt Junction Tuning Varactors

## Applications

- Low phase noise VCOs in wireless systems
- RF and microwave VCOs and phase shifters

## Features

- Low series resistance
- High capacitance ratio at low reverse voltage
- 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 SMV2019-SMV2023 series are silicon hyperabrupt junction varactor diodes. The capacitance ratio and low series resistance of these varactors make them attractive for low phase noise Voltage-Controlled Oscillators (VCOs) in wireless systems.

Table 1 describes the various packages and markings of the SMV2019-SMV2023 series of varactors.

**Table 1. Packaging and Marking**

				
Single	Common Cathode	Single	Single	Single
SOT-23	SOT-23	SOD-323 Green™	SC-79 Green™	SOD-882 Green™
			<b>SMV2019-079LF</b> Marking: Cathode	<b>SMV2019-040LF</b> Marking: Z
	<b>SMV2022-004</b> Marking: VJ3		<b>SMV2020-079LF</b> Marking: Cathode	
	<b>SMV2022-004LF</b> Green™ Marking: DJ3			
<b>SMV2023-001</b> Marking: VK1	<b>SMV2023-004</b> Marking: VK3			
<b>SMV2023-001LF</b> Green™ Marking: DK1	<b>SMV2023-004LF</b> Green™ Marking: DK3	<b>SMV2023-011LF</b> Marking: DK1		
Ls = 1.5 nH	Ls = 1.5 nH	Ls = 1.5 nH	Ls = 0.7 nH	Ls = 0.45 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.

**Table 2. SMV2019-SMV2023 Absolute Maximum Ratings**

Parameter	Symbol	Minimum	Maximum	Units
Reverse voltage	$V_R$		22	V
Forward current	$I_F$		20	mA
Power dissipation	$P_{DIS}$		250	mW
Operating temperature	$T_{OP}$	-55	+125	°C
Storage temperature	$T_{STG}$	-55	+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 SMV2019-SMV2023 series of varactors are Class 1B Human Body Model (HBM) ESD devices.

**Table 3. SMV2019-SMV2023 Electrical Specifications (Note 1) (Note 2)**  
( $T_{OP} = 25\text{ °C}$ , Unless Otherwise Noted)

Part Number	$C_T @ 4\text{ V}$ (pF)		$C_T @ 20\text{ V}$ (pF)		$\frac{C_T @ 4\text{ V}}{C_T @ 20\text{ V}}$ Ratio	$Q @ 4\text{ V},$ 50 MHz
	Minimum	Maximum	Minimum	Maximum	Minimum	Typical
SMV2019	0.65	0.95	0.26	0.34	2.30	500
SMV2020	1.20	1.53	0.30	0.43	2.80	500
SMV2022	2.50	3.30	0.60	0.85	3.00	500
SMV2023	4.40	5.40	0.90	1.20	4.20	500

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

**Note 2:** Reverse current,  $I_R$  ( $V_R = 16\text{ V}$ ): 50 nA maximum.

### Electrical and Mechanical Specifications

The absolute maximum ratings of the SMV2019-SMV2023 series of varactors are provided in Table 2. Electrical specifications are provided in Table 3. The relationship between capacitance and reverse voltage is illustrated in Figures 1, 2, and 3. Table 4 summarizes the capacitance of the SMV2019-SMV2023 series.

The SPICE model for the SMV2019-SMV2023 varactor series is shown in Figure 4 and the associated model parameters are provided in Table 5.

Package dimensions are provided in Figures 5 to 11 (odd numbers), and tape and reel drawings are provided in Figures 6 to 12 (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 SMV2019-SMV2023 varactors are rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. They 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.

### Typical Performance Characteristics

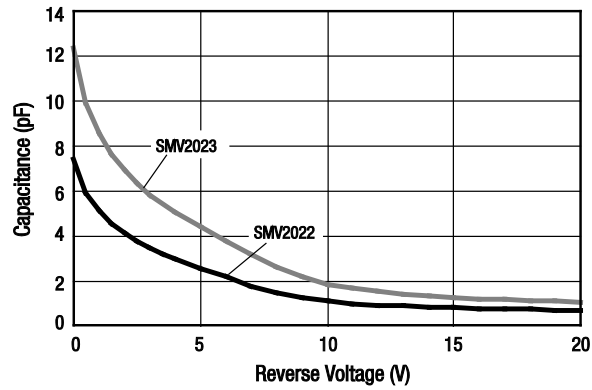


Figure 1. SMV2022 and SMV2023 Capacitance vs Reverse Voltage

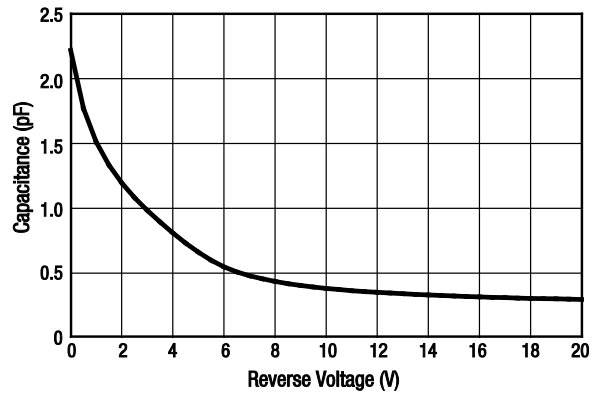


Figure 2. SMV2019-079LF Capacitance vs Reverse Voltage

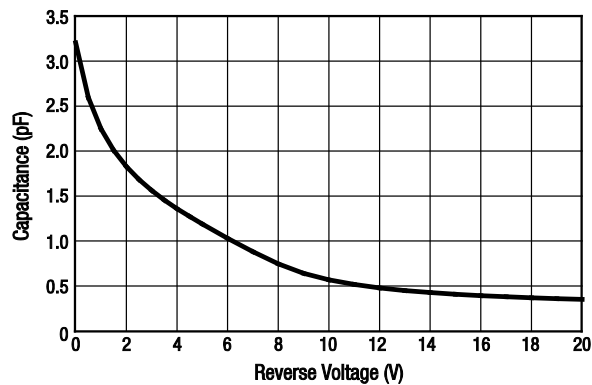


Figure 3. SMV2020-079LF Capacitance vs Reverse Voltage

**Table 4. Capacitance vs Reverse Voltage**

V <sub>R</sub> (V)	C <sub>T</sub> (pF)			
	SMV2019	SMV2020	SMV2022	SMV2023
0	2.22	3.20	7.41	12.33
0.5	1.77	2.59	5.94	9.90
1.0	1.51	2.25	5.14	8.60
1.5	1.33	2.01	4.56	7.62
2.0	1.20	1.83	4.14	6.94
2.5	1.08	1.68	3.78	6.34
3.0	0.98	1.56	3.49	5.88
3.5	0.89	1.46	3.23	5.45
4.0	0.81	1.36	3.01	5.09
5.0	0.66	1.19	2.54	4.42
6.0	0.55	1.03	2.18	3.77
7.0	0.48	0.88	1.80	3.18
8.0	0.44	0.75	1.50	2.63
9.0	0.40	0.64	1.29	2.21
10.0	0.38	0.57	1.11	1.86
11.0	0.37	0.52	1.03	1.68
12.0	0.35	0.48	0.96	1.54
13.0	0.34	0.45	0.91	1.44
14.0	0.33	0.43	0.87	1.37
15.0	0.32	0.41	0.83	1.30
16.0	0.32	0.39	0.81	1.25
17.0	0.31	0.38	0.78	1.20
18.0	0.31	0.37	0.76	1.16
19.0	0.30	0.36	0.75	1.13
20.0	0.30	0.35	0.73	1.09

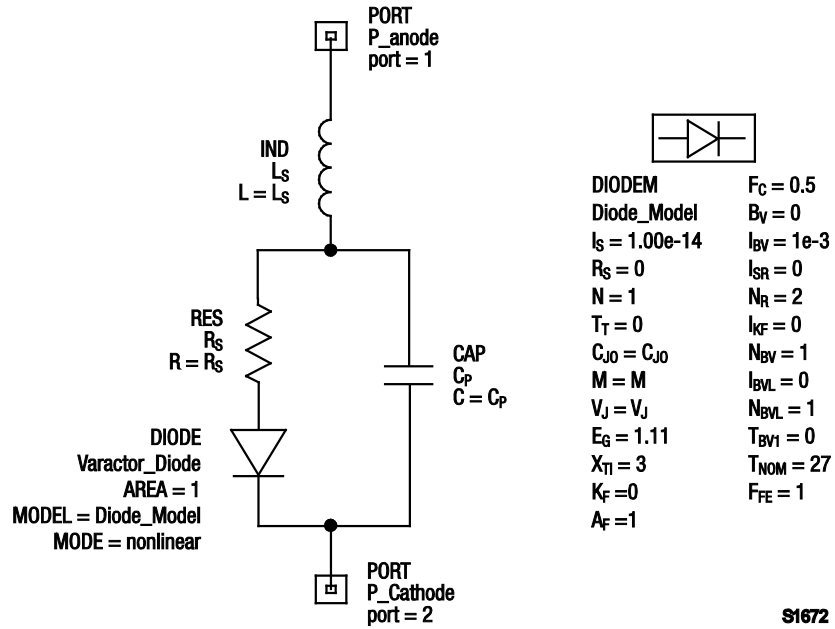
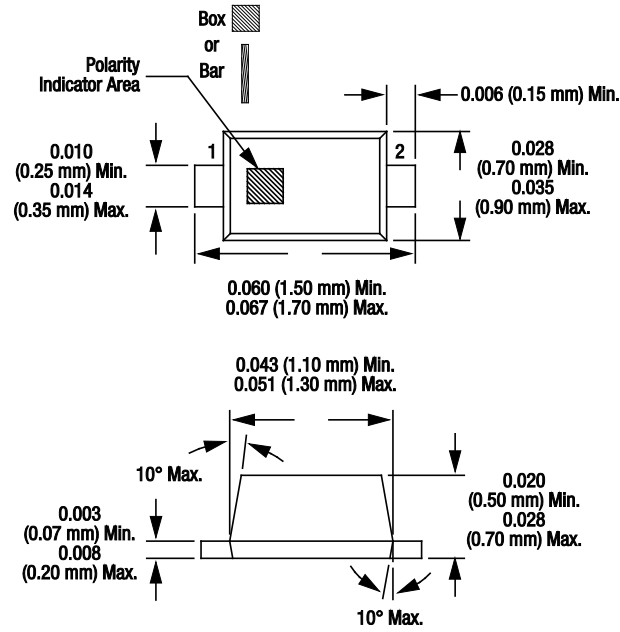


Figure 4. SPICE Model

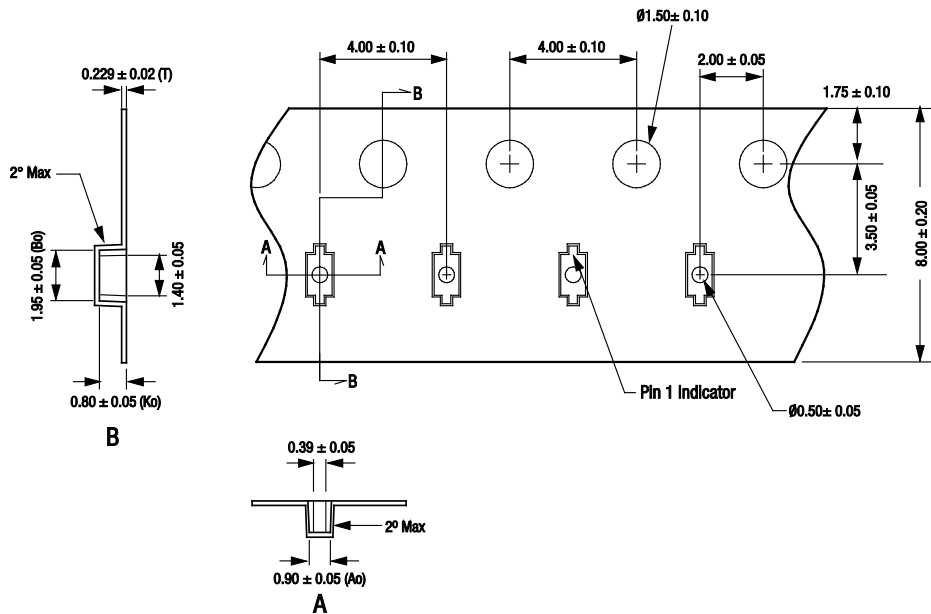
Table 5. SPICE Model Parameters

Part Number	C <sub>J0</sub> (pF)	V <sub>J</sub> (V)	M	C <sub>P</sub> (pF)	R <sub>S</sub> (Ω)	L <sub>S</sub> (nH)
SMV2019-079LF	2.25	3.5	1.4	0.07	4.8	0.7
SMV2019-040LF	2.25	3.5	1.4	0.07	4.8	0.45
SMV2020-079LF	3.20	4.4	1.45	0	2.5	0.7
SMV2022 series	7.30	4.0	1.4	0	2.2	1.5
SMV2023 series	12.23	4.0	1.4	0	1.6	1.5



Dimensions are in inches (millimeters shown in parentheses) S1652

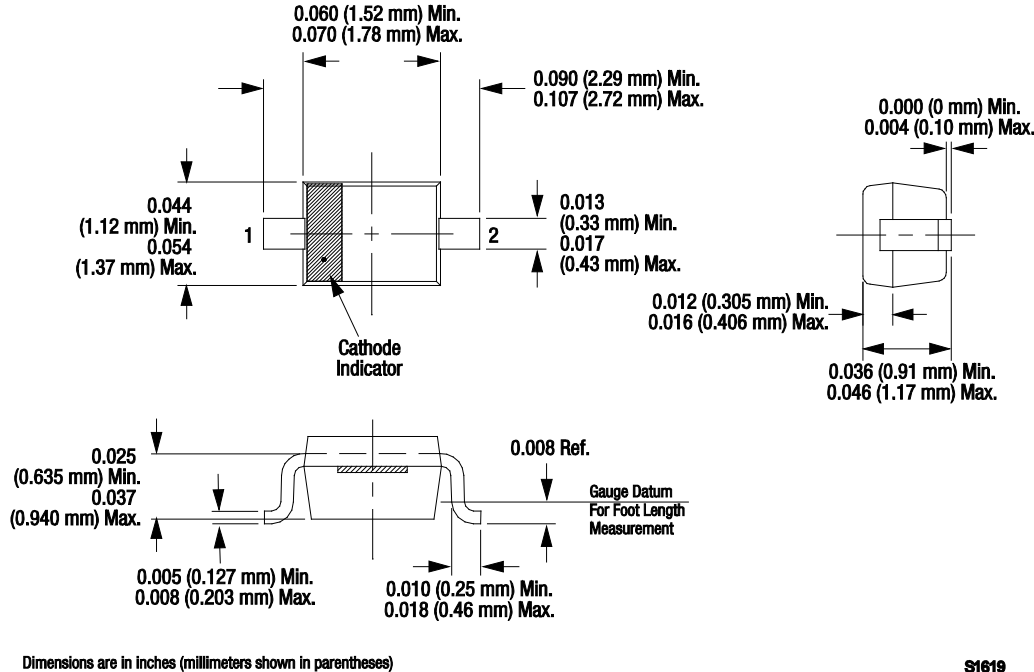
**Figure 5. SC-79 Package Dimensions**



- 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  $\leq 1 \times 10^8$  Ohms/square per EIA, JEDEC TNR Specification.
  4. All measurements are in millimeters.

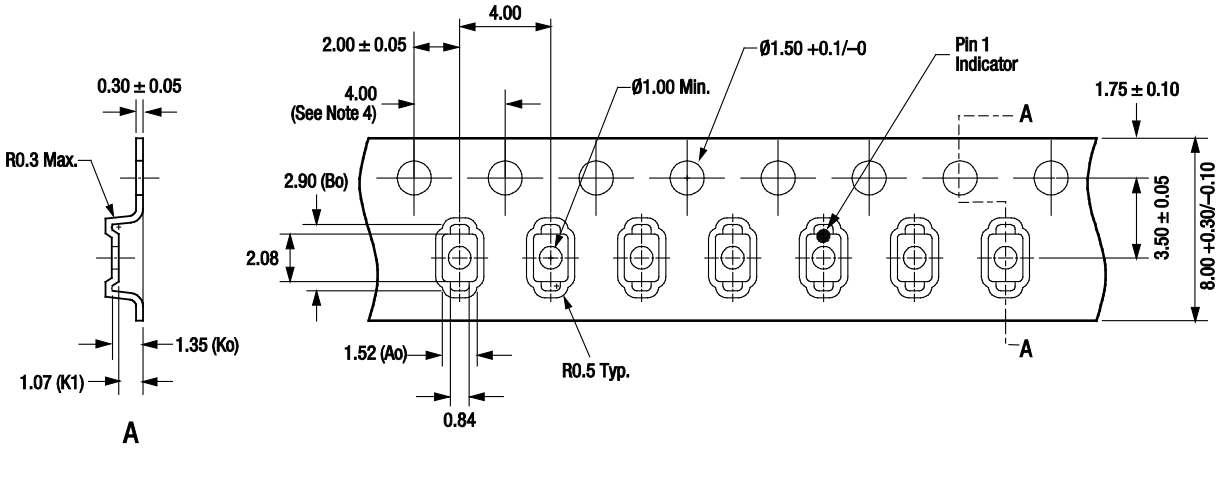
S2929

**Figure 6. SC-79 Tape and Reel Dimensions**



S1619

Figure 7. SOD-323 Package Dimensions



- 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 8. SOD-323 Tape and Reel Dimensions

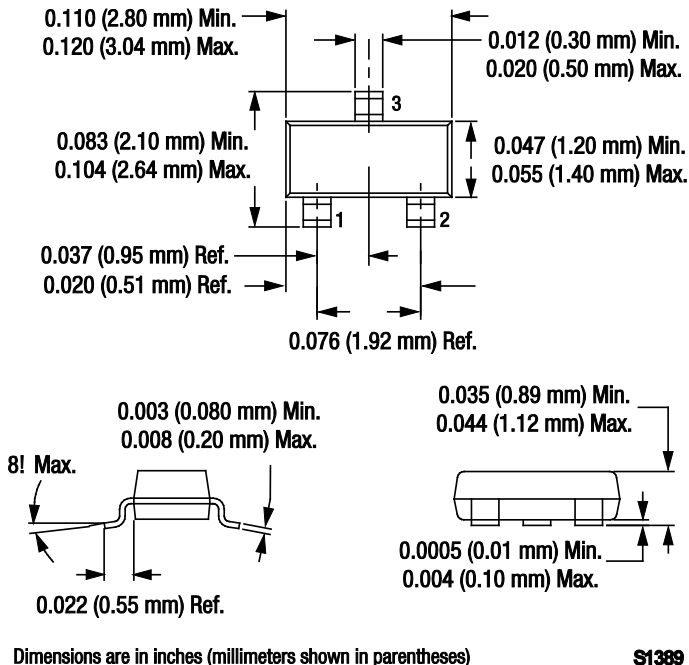
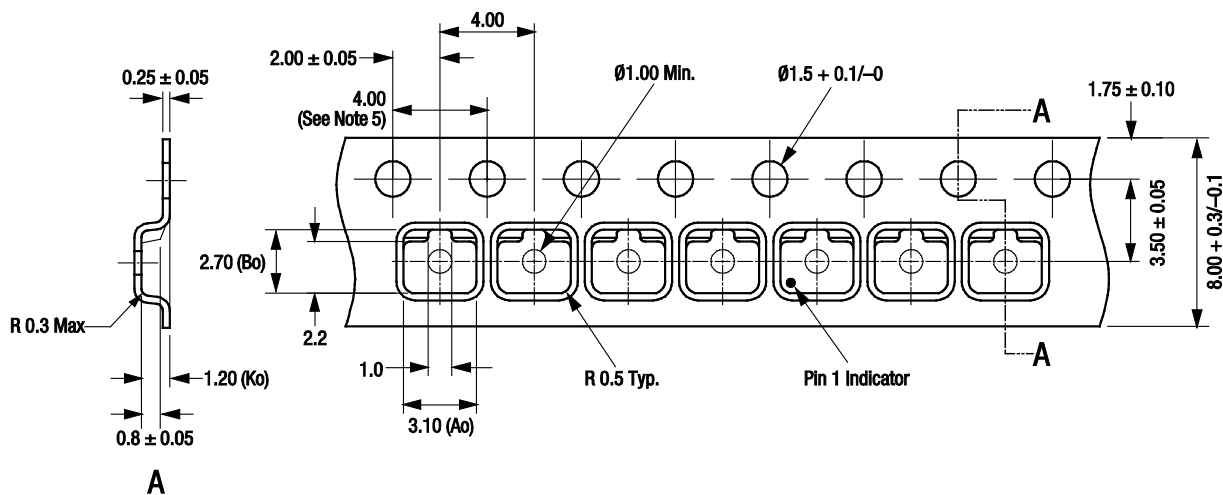


Figure 9. SOT-23 Package Dimensions

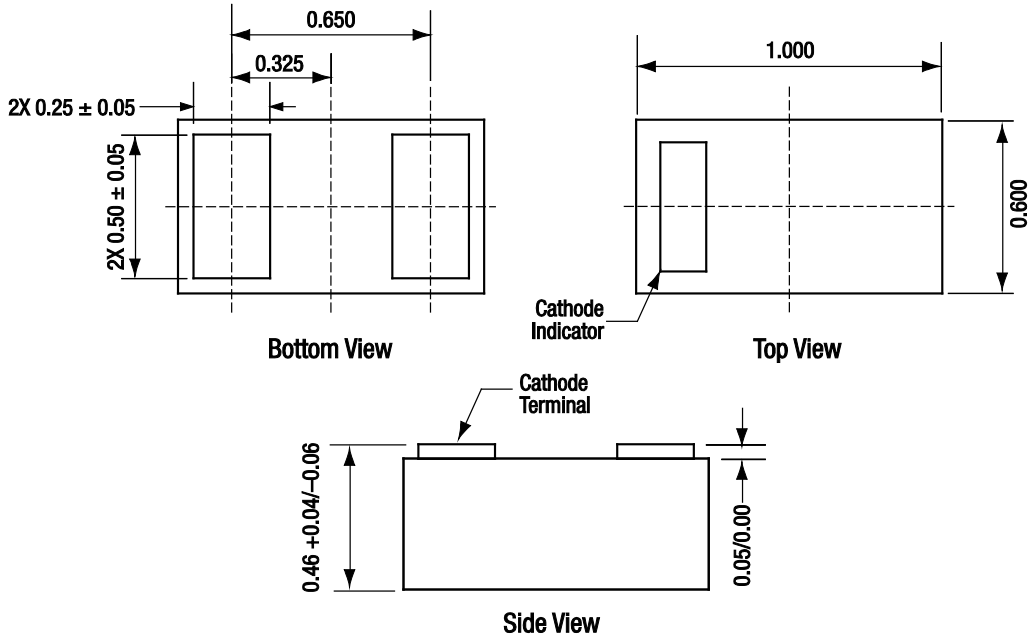


- Notes:
1. Carrier tape: black conductive polycarbonate.
  2. Cover tape material: transparent conductive PSA.
  3. Cover tape size: 5.40 mm width.
  4. Tolerance  $\pm 0.10$  mm.
  5. Ten sprocket hole pitch cumulative tolerance:  $\pm 0.2$  mm.
  6. All measurements are in millimeters.

S1684b

Figure 10. SOT-23 Tape and Reel Dimensions

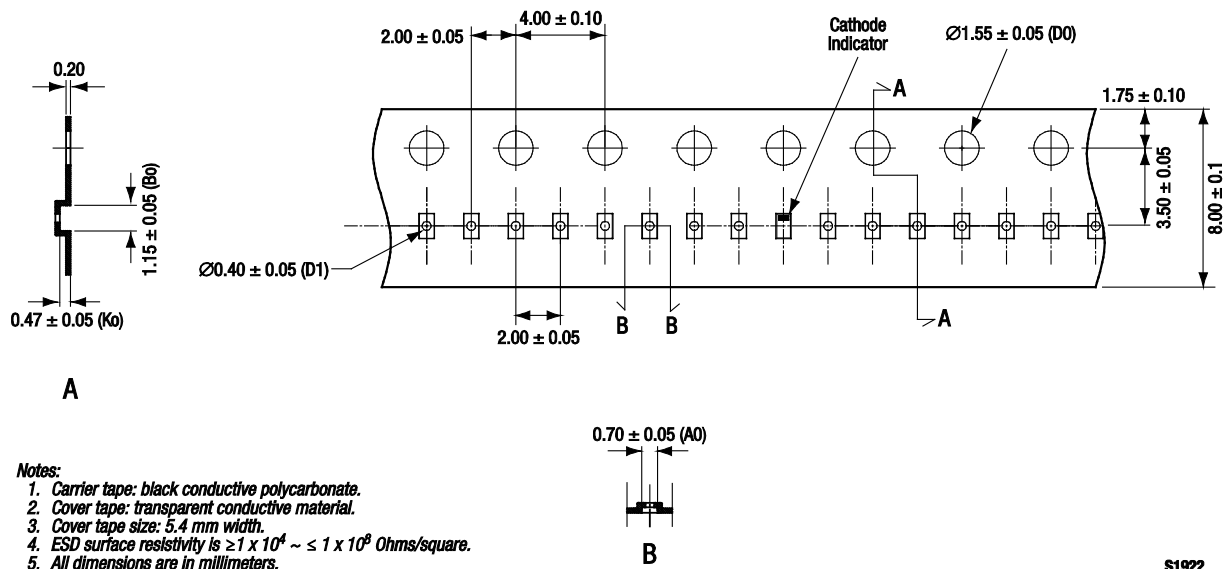




All dimensions in millimeters

S1882

Figure 11. SOD-882 Package Dimensions



- 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 12. SOD-882 Tape and Reel Dimensions

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