

DATA SHEET

SMV123x Series: Hyperabrupt Junction Tuning Varactors

Applications

- Low tuning voltage VCOs
- High-Q resonators in wireless system VCOs
- High-volume commercial systems

Features

- High capacitance ratio
- Low series resistance for low phase noise
- 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 SMV123x series of silicon hyperabrupt junction varactor diodes are designed for use in Voltage Controlled Oscillators (VCOs) with a low tuning voltage operation. The low resistance of these varactors makes them appropriate for high-Q resonators in wireless system VCOs to frequencies over 10 GHz. This family of varactors is characterized for capacitance and resistance over temperature.

Table 1 describes the various packages and markings of the SMV123x varactors.

Table 1. Packaging and Marking

					
Single	Single	Single	Common Cathode	Common Cathode	Single
SC-79 Green™	SOD-323 Green™	SOT-23	SOT-23	SC-70	SOD-882 Green™
SMV1231-079LF Marking: Cathode and HF				SMV1231-074LF Green™ Marking: KA3	SMV1231-040LF Marking: A
SMV1232-079LF Marking: Cathode and HG					SMV1232-040LF Marking: Y
SMV1233-079LF Marking: Cathode and HK					SMV1233-040LF Marking: B
SMV1234-079LF Marking: Cathode and HS	♦ SMV1234-011LF Marking: DQ		SMV1234-004LF Green™ Marking: DQ3		SMV1234-040LF Marking: G
SMV1235-079LF Marking: Cathode and HX					SMV1235-040LF Marking: M
♦ SMV1236-079LF Marking: Cathode and HY	SMV1236-011LF Marking: EQ				SMV1236-040LF Marking: R
		SMV1237-001LF Green™ Marking: DT1			
Ls = 0.7 nH	Ls = 1.5 nH	Ls = 1.5 nH	Ls = 1.5 nH	Ls = 1.4 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.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SMV123x varactors are provided in Table 2. Electrical specifications are provided in Table 3. Typical capacitance values are listed in Table 4. Typical performance characteristics of the SMV123x varactors are illustrated in Figures 1 through 4.

The SPICE model for the SMV123x varactors is shown in Figure 5 and the associated model parameters are provided in Table 5.

Package dimensions are shown in Figures 6 to 14 (even numbers), and tape and reel dimensions are provided in Figures 7 to 15 (odd 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 SMV123x series 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.

Table 2. SMV123x Absolute Maximum Ratings¹

Parameter	Symbol	Minimum	Maximum	Units
Reverse voltage	V_R		15	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
Electrostatic discharge: Human Body Model (HBM), Class 1B	ESD		1000	V

¹ 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.

ESD HANDLING: *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 when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.*

Table 3. SMV123x Electrical Specifications¹
(T_{OP} = 25 °C, Unless Otherwise Noted)

Part Number	C _T @ 1 V (pF)		C _T @ 3 V (pF)	C _T @ 6 V (pF)	C _T @ 1 V C _T @ 3 V (Ratio)		C _T @ 1 V C _T @ 6 V (Ratio)		R _s @ 3 V, 500 MHz (Ω)
	Min	Max	Typ	Typ	Min	Max	Min	Max	Typ
SMV1231	1.43	1.72	0.97	0.61	1.5	1.8	2.5	2.8	2.90
SMV1232	2.34	2.86	1.50	0.94	1.5	1.9	2.6	3.3	1.50
SMV1233	3.00	3.60	1.80	1.10	1.5	1.9	2.6	3.3	1.20
SMV1234	5.85	7.15	3.60	2.00	1.6	2.0	2.8	3.4	0.80
SMV1235	10.35	12.65	6.40	3.60	1.6	2.0	2.9	3.4	0.60
SMV1236	15.50	18.50	9.20	5.30	1.6	2.0	3.0	3.5	0.50
SMV1237	45.00	54.00	26.90	14.40	1.6	2.0	3.0	3.5	0.40

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

Tested with -079 package.

Reverse voltage V_R (I_R = 10 μA) = 15 V minimumReverse current I_R (V_R = 12 V) = 20 nA maximum**Table 4. Capacitance vs Reverse Voltage**

V _R (V)	C _T (pF)						
	SMV1231	SMV1232	SMV1233	SMV1234	SMV1235	SMV1236	SMV1237
0	2.35	4.15	5.08	9.63	18.22	26.75	71.82
0.5	1.87	3.22	3.95	7.53	14.12	20.61	56.10
1.0	1.58	2.67	3.28	6.28	11.67	17.02	46.89
1.5	1.40	2.28	2.80	5.39	9.91	14.38	40.33
2.0	1.22	1.97	2.41	4.68	8.52	12.29	35.13
2.5	1.09	1.72	2.09	4.09	7.36	10.56	30.71
3.0	0.970	1.51	1.82	3.58	6.40	9.16	26.87
3.5	0.882	1.35	1.62	3.15	5.62	8.04	23.57
4.0	0.794	1.22	1.45	2.81	4.99	7.19	20.83
4.5	0.732	1.13	1.33	2.54	4.50	6.53	18.62
5.0	0.683	1.05	1.24	2.32	4.11	6.01	16.87
5.5	0.648	0.99	1.16	2.15	3.80	5.61	15.48
6.0	0.613	0.94	1.10	2.02	3.55	5.28	14.36
6.5	0.590	0.90	1.05	1.90	3.34	5.02	13.46
7.0	0.567	0.86	1.01	1.80	3.17	4.81	12.72
7.5	0.551	0.84	0.98	1.72	3.03	4.64	12.11
8.0	0.534	0.81	0.96	1.65	2.91	4.49	11.61
9.0	0.512	0.78	0.92	1.55	2.73	4.28	10.87
10.0	0.497	0.76	0.90	1.47	2.61	4.13	10.38
11.0	0.492	0.75	0.88	1.42	2.53	4.02	10.06
12.0	0.487	0.74	0.87	1.38	2.47	3.95	9.84
13.0	0.480	0.73	0.86	1.35	2.43	3.89	9.68
14.0	0.472	0.73	0.85	1.33	2.40	3.84	9.56
15.0	0.466	0.72	0.84	1.32	2.38	3.80	9.47

Typical Performance Characteristics

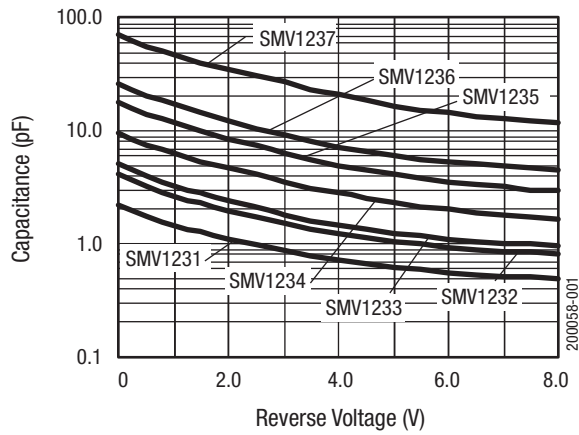


Figure 1. Capacitance vs Reverse Voltage

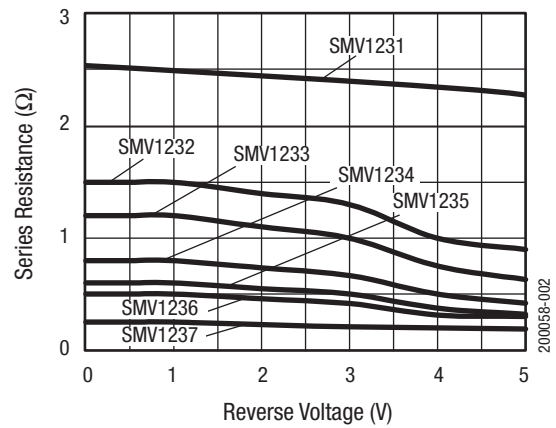


Figure 2. Series Resistance vs Reverse Voltage @ 500 MHz

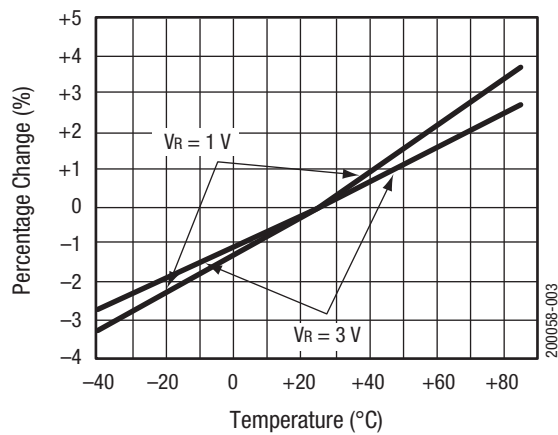


Figure 3. Relative Capacitance Change vs Temperature

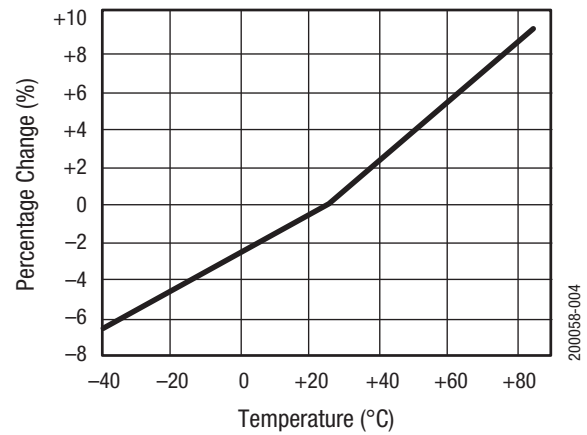


Figure 4. Relative Series Resistance Change vs Temperature @ 500 MHz

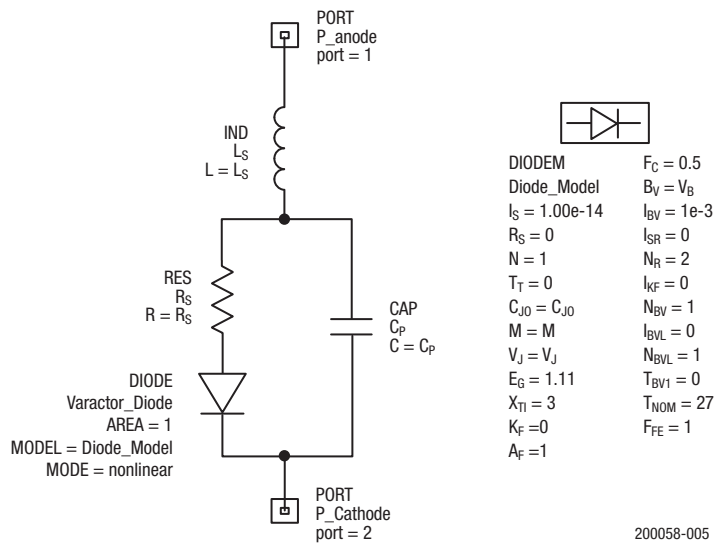


Figure 5. SPICE Model

Table 5. SPICE Model Parameters¹

Part Number	CJO (pF)	VJ (V)	M	CP (pF)	RS (Ω)
SMV1231	1.88	10.13	4.999	0.44	2.50
SMV1232	3.43	8.36	4.690	0.68	1.50
SMV1233	4.21	11.87	6.430	0.81	1.20
SMV1234	8.36	7.95	3.960	1.15	0.80
SMV1235	15.85	8.78	4.570	2.15	0.60
SMV1236	22.89	9.62	5.230	3.59	0.50
SMV1237	61.40	14.51	6.780	8.90	0.25

¹ Values extracted from measured performance.
For package inductance (Ls), refer to Table 1.
For more details, refer to the Skyworks Application Note, *Varactor SPICE Model for Approved RF VCO Applications*, document number 200315.

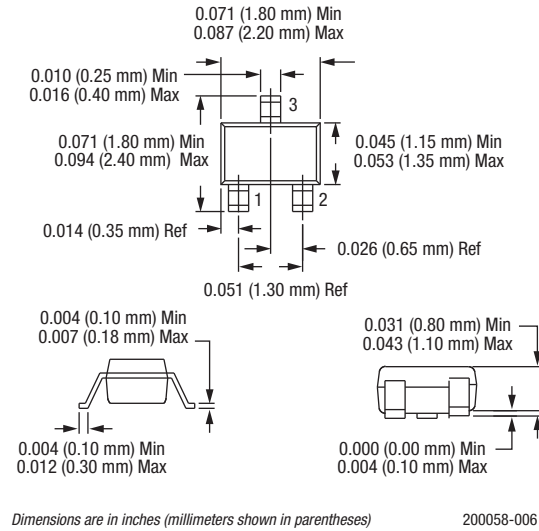
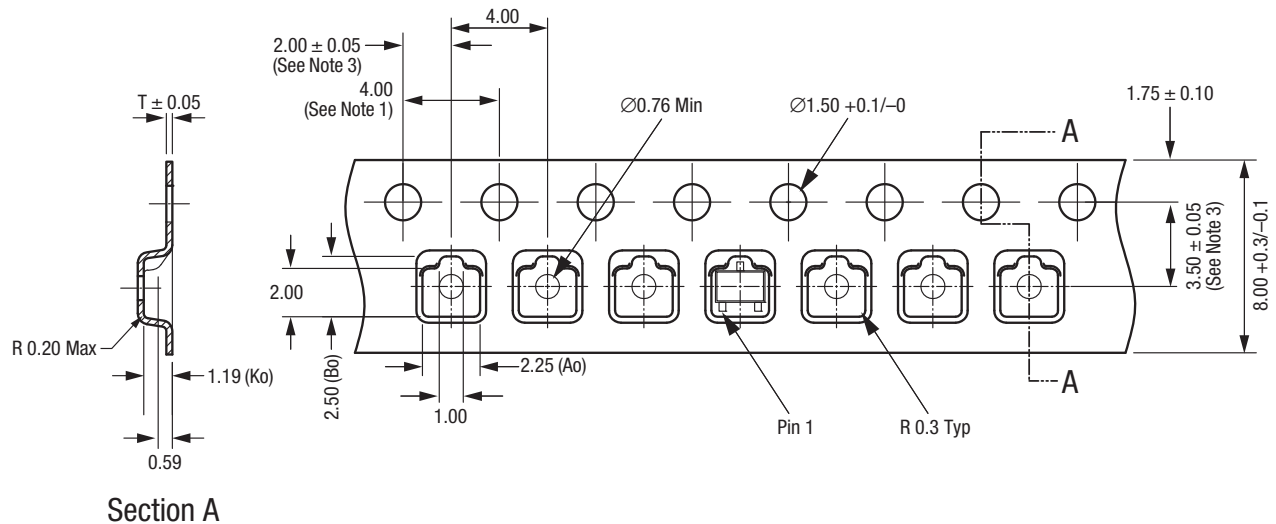


Figure 6. SC-70 Package Dimensions



Section A

Notes:

1. Sprocket hole pitch cumulative tolerance ± 0.2 mm.
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 and conductive material.
5. All measurements are in millimeters.

200058-007

Figure 7. SC-70 Tape and Reel Dimensions

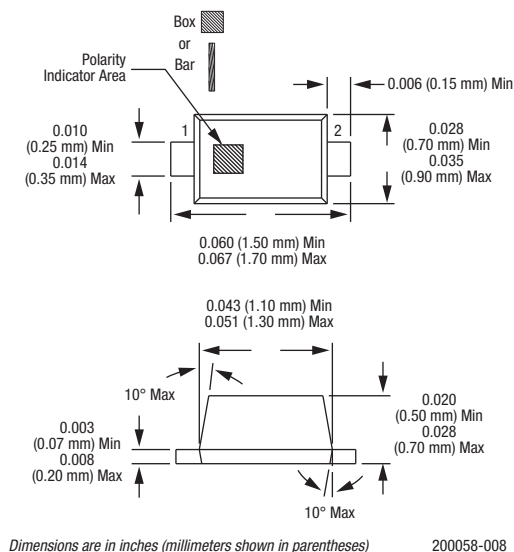
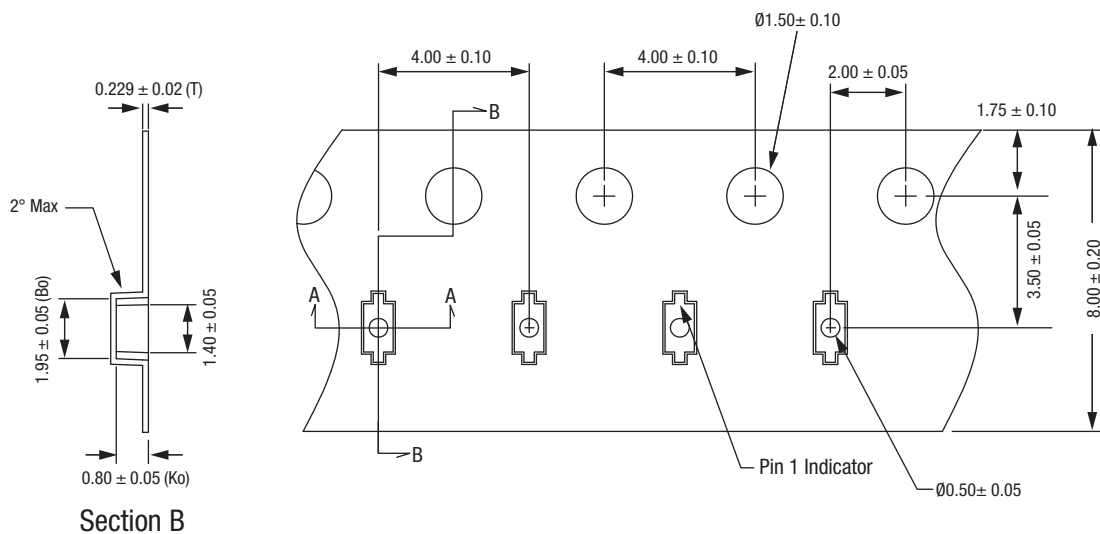
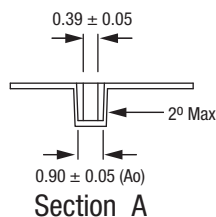


Figure 8. SC-79 Package Dimensions



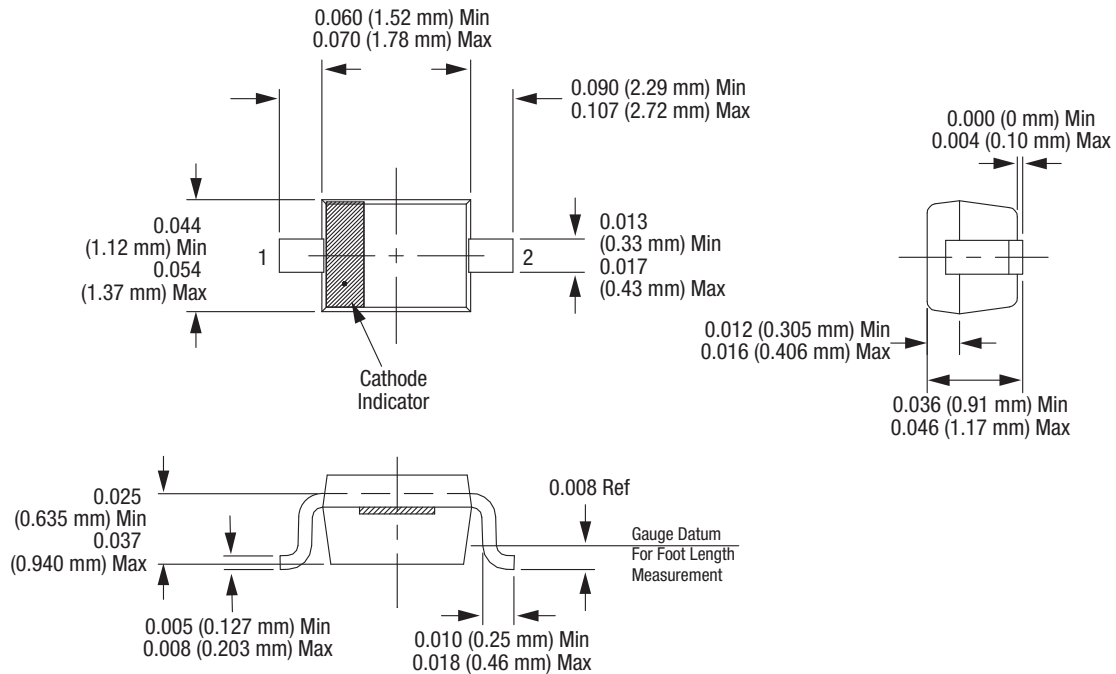
Notes:

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.
5. All measurements are in millimeters.



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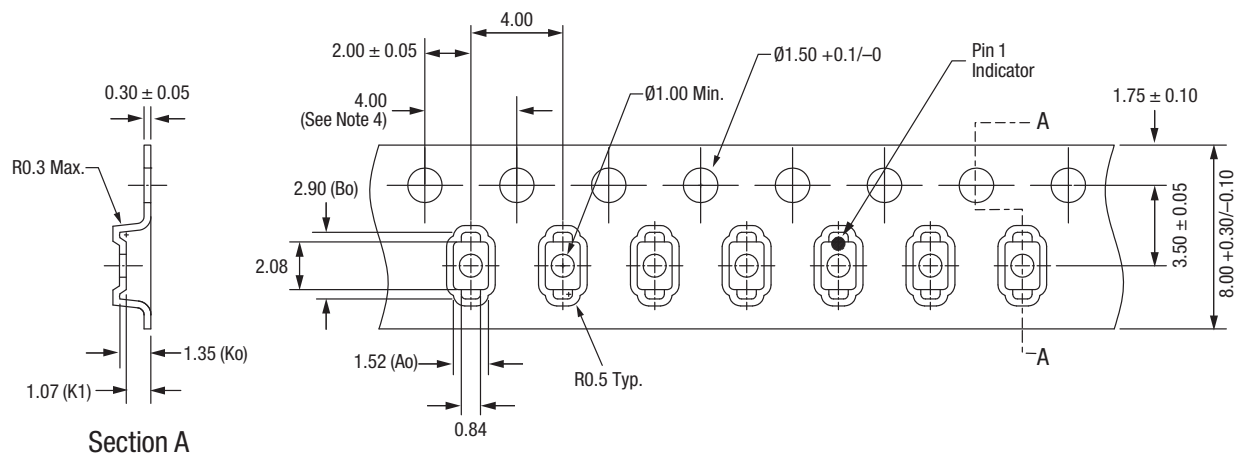
Figure 9. SC-79 Tape and Reel Dimensions



Dimensions are in inches (millimeters shown in parentheses)

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Figure 10. SOD-323 Package Dimensions



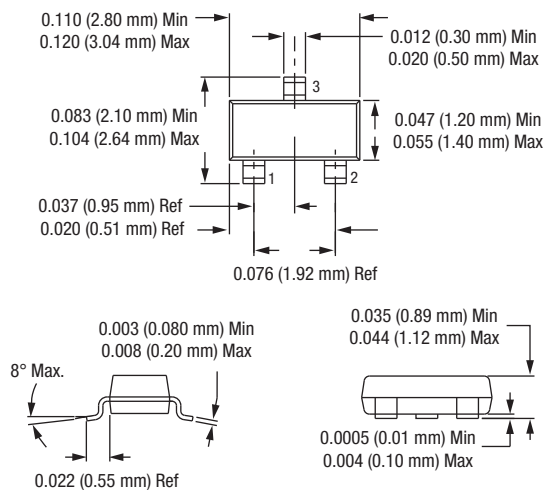
Section A

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.

200058-011

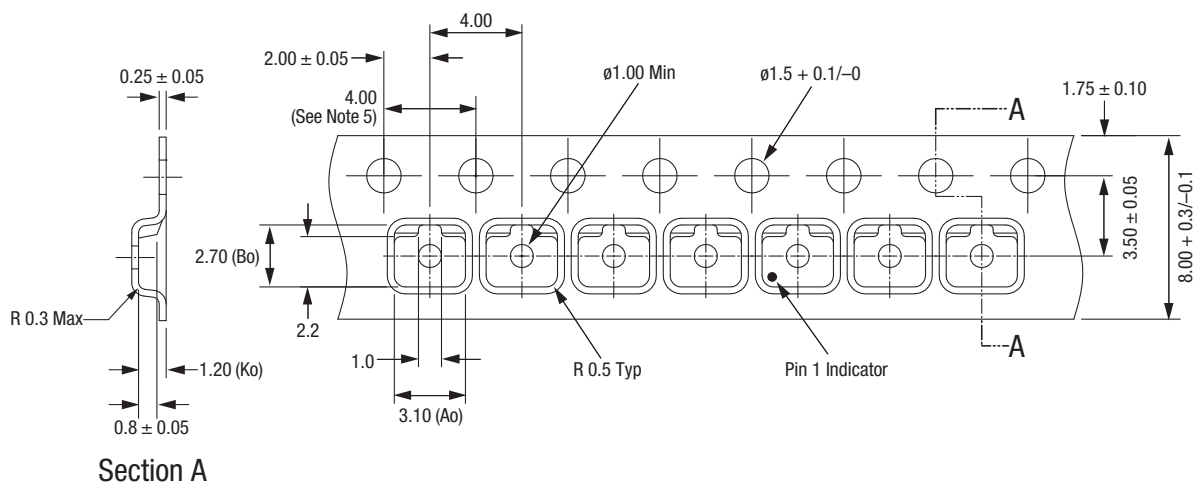
Figure 11. SOD-323 Tape and Reel Dimensions



Dimensions are in inches (millimeters shown in parentheses)

200058-012

Figure 12. SOT-23 Package Dimensions



Section A

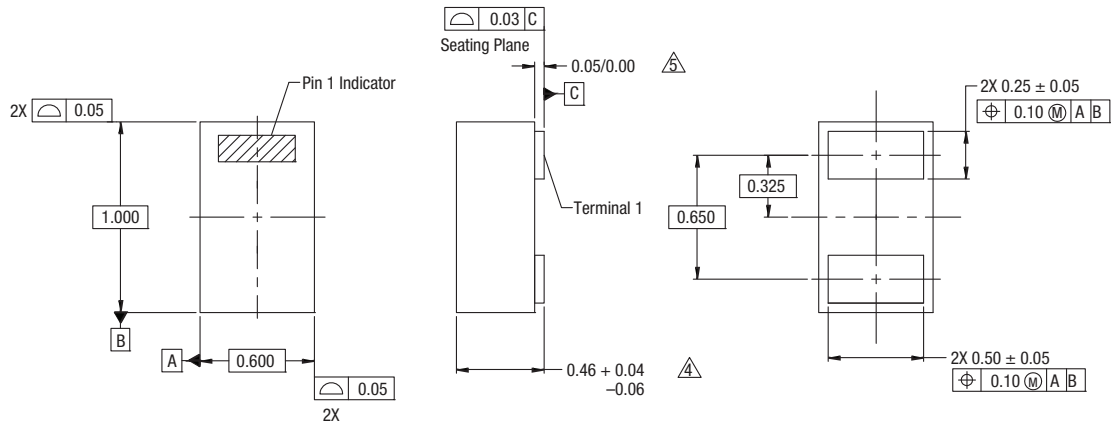
Notes:

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.
7. Alternative carrier tape dimensions are:

$$\begin{aligned} A_0 &= 3.3 \\ B_0 &= 2.9 \\ K_0 &= 1.22 \end{aligned}$$

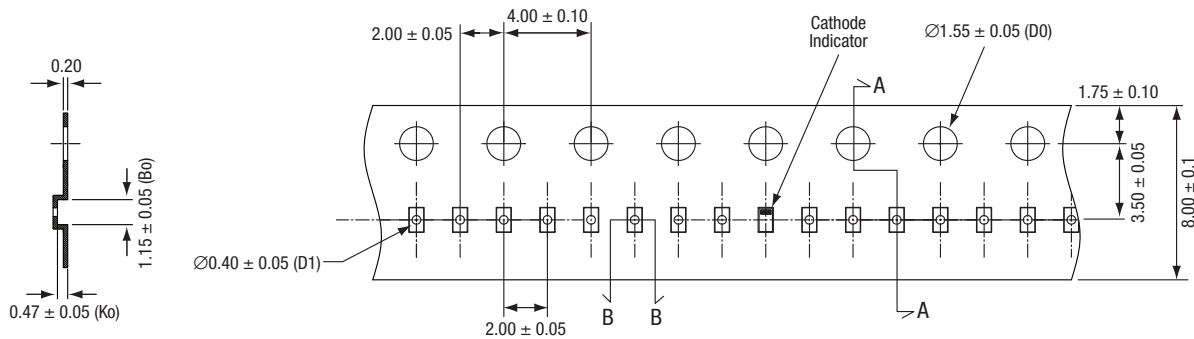
200058-013

Figure 13. SOT-23 Tape and Reel Dimensions

**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.

200058-014

Figure 14. SOD-882 Package Dimensions**Section A****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 $\geq 1 \times 10^4 \sim 1 \times 10^8$ Ohms/square.
5. All dimensions are in millimeters.

0.70 ± 0.05 (A0)

Section B

200058-015

Figure 15. SOD-882 Tape and Reel Dimensions

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<u>SMV1236-079LF</u>	<u>SMV1237-001LF</u>	<u>SMV1234-004LF</u>	<u>SMV1233-001LF</u>	<u>SMV1231-074LF</u>	<u>SMV1235-079LF</u>