

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

NEW

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



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 2.5 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 Anode	Common Cathode
SC-79	SOD-323	SOT-23	SOT-23	SC-70	SC-70
					SMV1231-074 Marking: JA3
SMV1231-079LF Marking: Cathode	SMV1231-011LF Marking: KA				SMV1231-074LF Marking: KA3
					SMV1232-074 Marking: CC3
SMV1232-079LF Marking: Cathode	SMV1232-011LF Marking: HC				SMV1232-074LF Marking: HC3
		SMV1233-001 Marking: VP1	SMV1233-004 Marking: VP3		SMV1233-074 Marking: VP3
SMV1233-079LF Marking: Cathode	◆ SMV1233-011LF Marking: DP	SMV1233-001LF Marking: DP1	SMV1233-004LF Marking: DP3		SMV1233-074LF Marking: DP3
		SMV1234-001 Marking: VQ1	SMV1234-004 Marking: VQ3	SMV1234-073 Marking: VQ9	
SMV1234-079LF Marking: Cathode	◆ SMV1234-011LF Marking: DQ	SMV1234-001LF Marking: DQ1	SMV1234-004LF Marking: DQ3	SMV1234-073LF Marking: DQ9	
		SMV1235-001 Marking: VR1	SMV1235-004 Marking: VR3		SMV1235-074 Marking: VR3
SMV1235-079LF Marking: Cathode	SMV1235-011LF Marking: DR	SMV1235-001LF Marking: DR1	SMV1235-004LF Marking: DR3		SMV1235-074LF Marking: DR3
		SMV1236-001 Marking: AQ1	SMV1236-004 Marking: AQ3		SMV1236-074 Marking: AQ3
◆ SMV1236-079LF Marking: Cathode	SMV1236-011LF Marking: EQ	SMV1236-001LF Marking: EQ1	SMV1236-004LF Marking: EQ3		SMV1236-074LF Marking: EQ3
		SMV1237-001 Marking: VT1			
		SMV1237-001LF Marking: DT1			
Ls = 0.7 nH	Ls = 1.5 nH	Ls = 1.5 nH	Ls = 1.5 nH	Ls = 1.4 nH	Ls = 1.4 nH



LF denotes lead (Pb)-free, RoHS-compliant packaging option as an alternative to the standard Skyworks tin/lead (Sn/Pb) packaging.



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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 12 (even numbers), and tape and reel dimensions are provided in Figures 7 to 13 (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 SMV121x series of 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. 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. SMV123x Absolute Maximum Ratings

Parameter	Symbol	Minimum	Typical	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

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 SMV123x varactors are Class 1B Human Body Model (HBM) ESD devices.

Table 3. SMV123x Electrical Specifications (Note 1)
(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)		Rs @ 3 V, 500 MHz (Ω)	Q @ 3 V, 50 MHz
	Min.	Max.	Typ.	Typ.	Min.	Max.	Min.	Max.	Max.	Typ.
SMV1231	1.43	1.72	0.97	0.61	1.5	1.8	2.5	2.8	2.90	1500
SMV1232	2.34	2.86	1.50	0.94	1.5	1.9	2.6	3.3	1.50	1400
SMV1233	3.00	3.60	1.80	1.10	1.5	1.9	2.6	3.3	1.20	1200
SMV1234	5.85	7.15	3.60	2.00	1.6	2.0	2.8	3.4	0.80	1000
SMV1235	10.35	12.65	6.40	3.60	1.6	2.0	2.9	3.4	0.60	750
SMV1236	15.50	18.50	9.20	5.30	1.6	2.0	3.0	3.5	0.50	700
SMV1237	45.00	54.00	26.90	14.40	1.6	2.0	3.0	3.5	0.25	500

Note 1: Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

Tested with -079 package.

Reverse voltage V_R (I_R = 10 μA) = 15 V minimum

Reverse 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

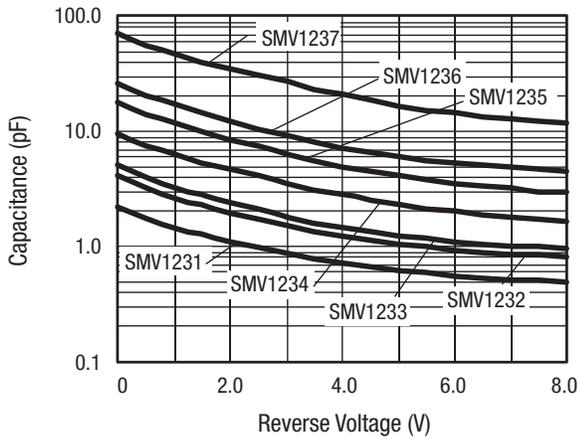


Figure 1. Capacitance vs Reverse Voltage

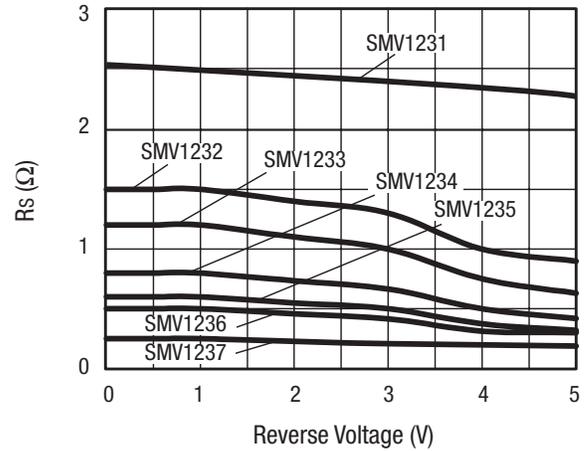


Figure 2. Series Resistance vs Reverse Voltage @ 500 MHz

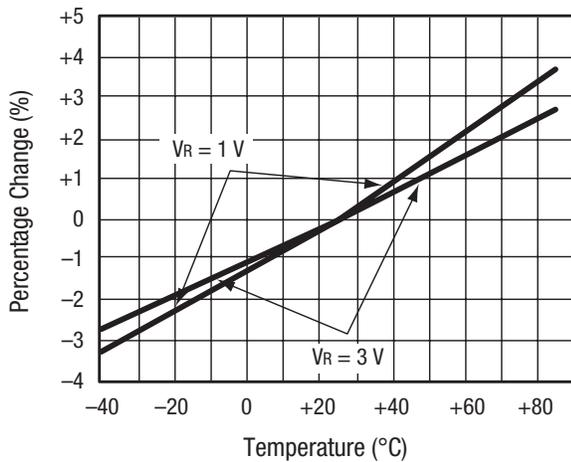


Figure 3. Relative Capacitance Change vs Temperature

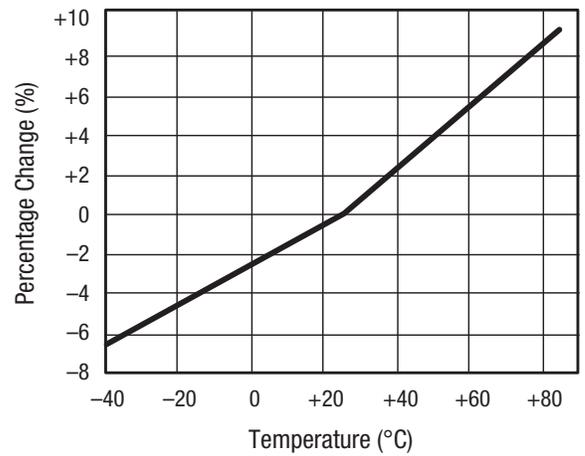


Figure 4. Relative Series Resistance Change vs Temperature @ 500 MHz

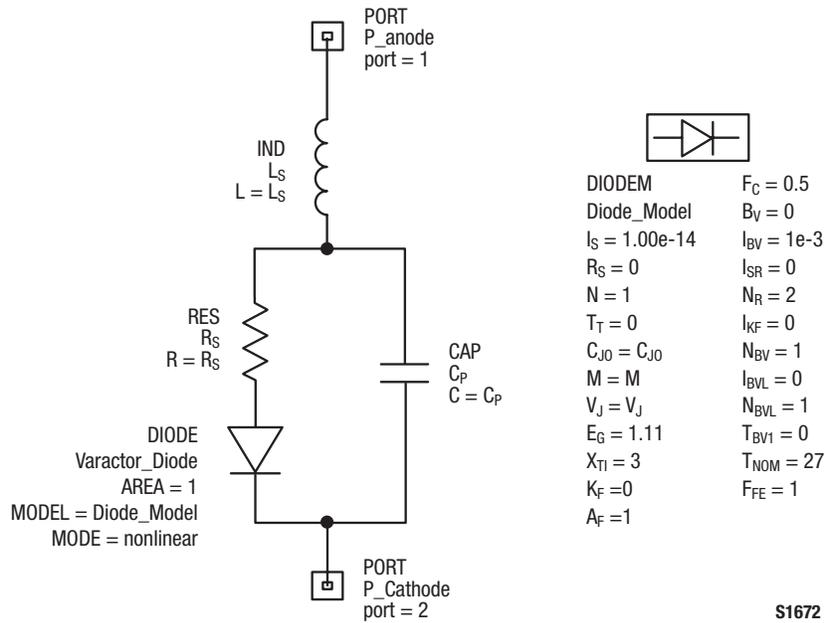


Figure 5. SPICE Model

Table 5. SPICE Model Parameters

Part Number	Cj0 (pF)	Vj (V)	M	Cp (pF)	Rs (Ω)
SMV1231	–	1.5	0.8	0	2.50
SMV1232	4.20	1.7	0.9	0	1.50
SMV1233	4.12	1.7	0.9	0.7	1.20
SMV1234	8.75	2.3	1.1	1.2	0.80
SMV1235	16.13	8.0	4.0	2.0	0.60
SMV1236	21.63	8.0	4.2	3.2	0.50
SMV1237	66.16	10.0	5.3	9.0	0.25

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.

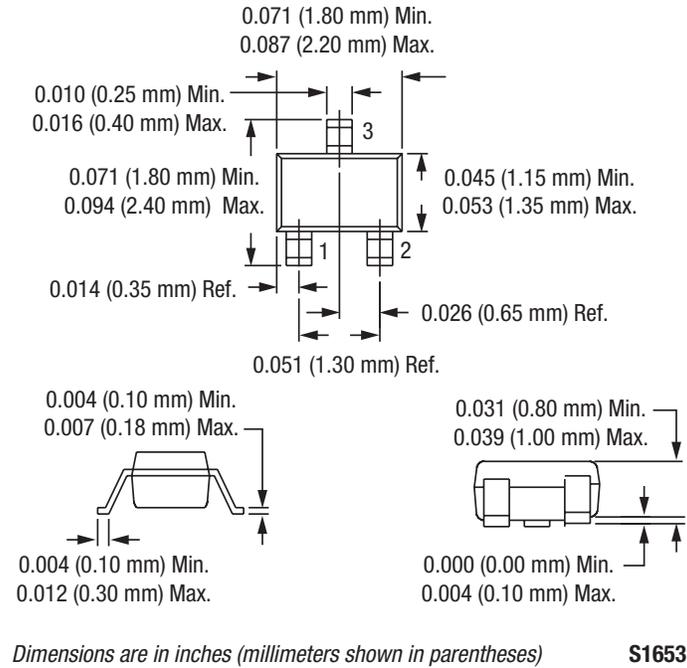


Figure 6. SC-70 Package Dimensions

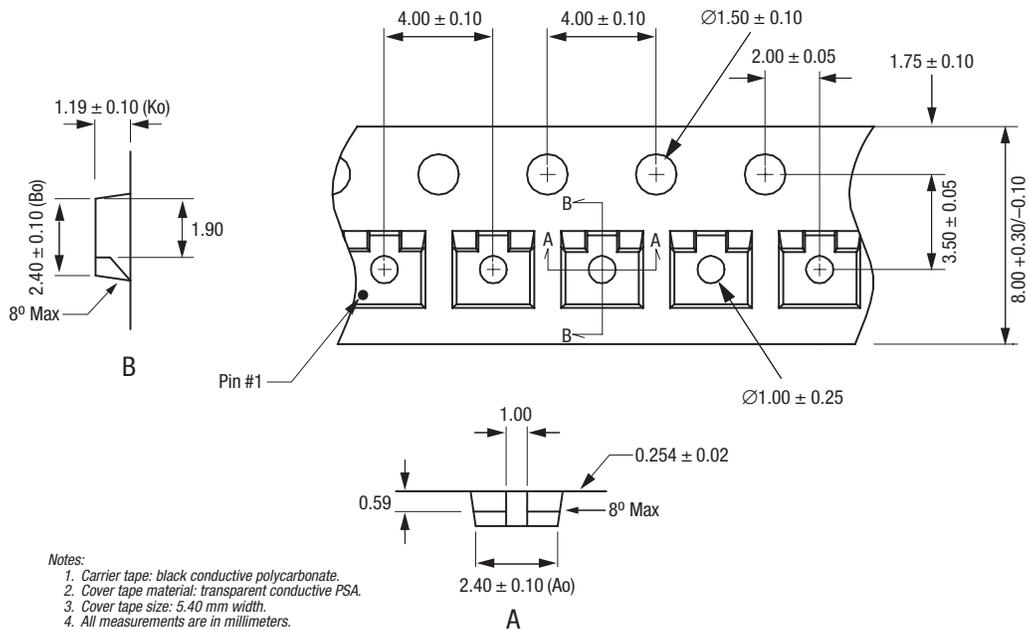
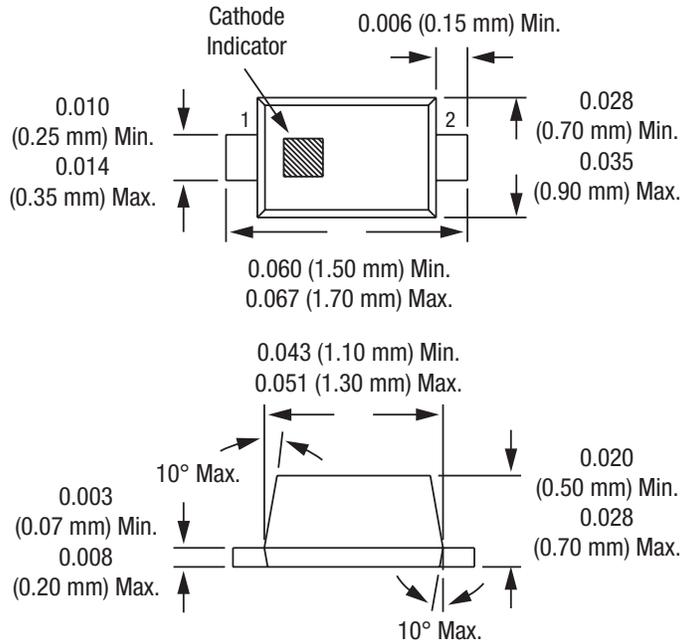
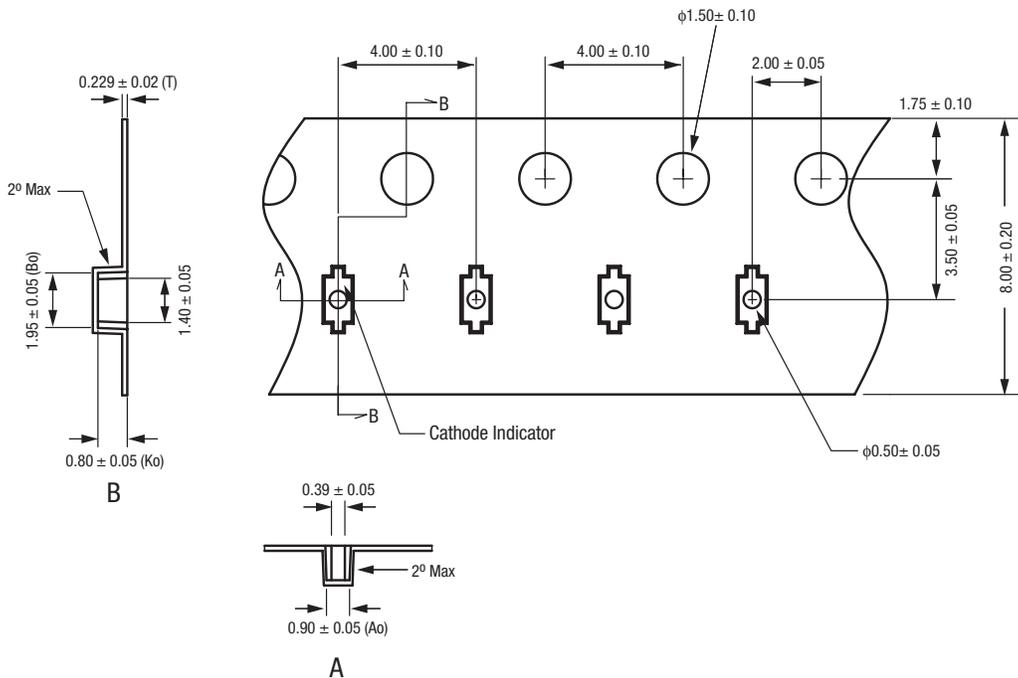


Figure 7. SC-70 Tape and Reel Dimensions



Dimensions are in inches (millimeters shown in parentheses) S1652

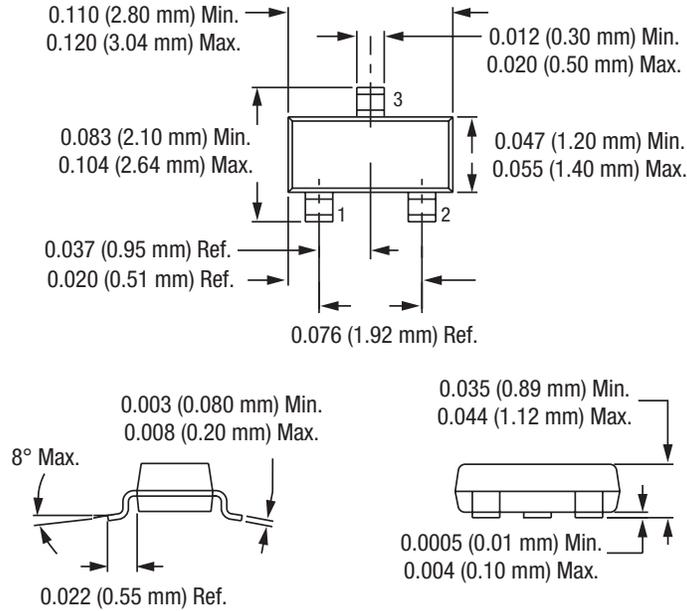
Figure 8 SC-79 Package Dimensions



- 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. All measurements are in millimeters.

S1673

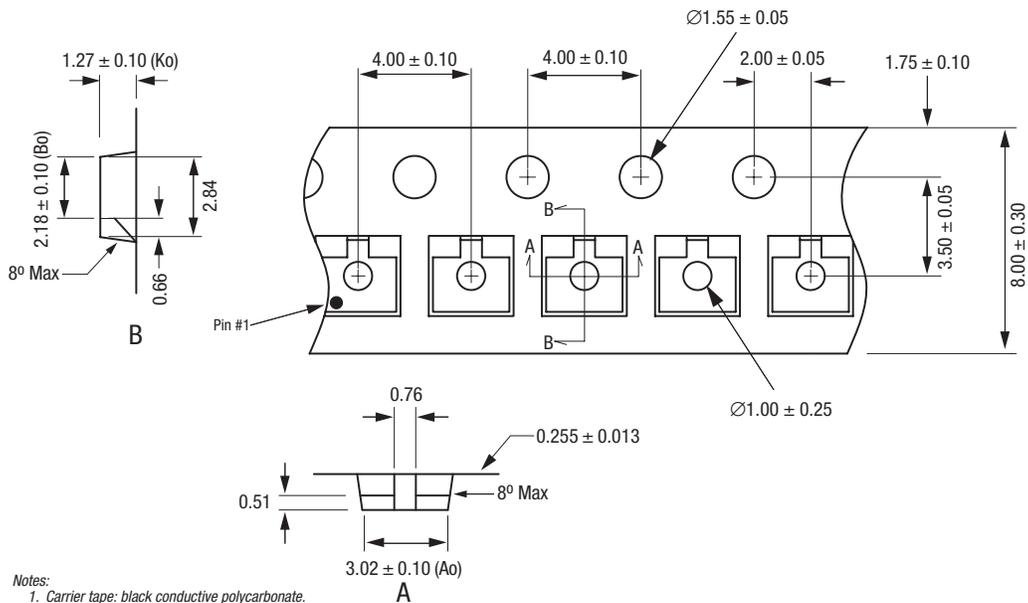
Figure 9. SC-79 Tape and Reel Dimensions



Dimensions are in inches (millimeters shown in parentheses)

S1389

Figure 12. 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 ±0.10 mm.
 5. All measurements are in millimeters.

S1684

Figure 13. SOT-23 Tape and Reel Dimensions

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