DATA SHEET

SMV1247-SMV1255 Series: Hyperabrupt Junction Tuning Varactors

Applications

- Low tuning voltage VCOs
- High-volume commercial systems

Features

- High capacitance ratio: $C_{0.3V}/C_{4.7V}$ = 12 typical
- 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 SMV1247-SMV1255 group of silicon hyperabrupt junction varactor diodes is designed for use in Voltage Controlled Oscillators (VCOs) with a low tuning voltage operation. This group of varactors is characterized for capacitance and resistance over temperature.

Table 1 describes the various packages and markings of the SMV1247 to SMV1255 varactors.

Table 1. Packaging and Marking

					
Single	Single	Single	Common Anode	Common Cathode	Single
SC-79 Green™	SOD-323 Green™	SOT-23	SOT-23	SOT-23	SOD-882 Green™
♦ **SMV1247-079LF** Marking: Cathode	**SMV1247-011LF** Marking: GF				**SMV1247-040LF** Marking: H
SMV1248-079LF Marking: Cathode		**SMV1248-001** Marking: BG1			
		SMV1248-001LF Green™ Marking: GG1			**SMV1248-040LF** Marking: 8
		SMV1249-001 Marking: AF1	**SMV1249-003** Marking: AF9	**SMV1249-004** Marking: AF3	
♦ **SMV1249-079LF** Marking: Cathode	**SMV1249-011LF** Marking: EF	**SMV1249-001LF** Green™ Marking: EF1	**SMV1249-003LF** Green™ Marking: EF9	**SMV1249-004LF** Green™ Marking: EF3	**SMV1249-040LF** Marking: K
				SMV1251-004 Marking: AH3	
SMV1251-079LF Marking: Cathode	**SMV1251-011LF** Marking: EH	**SMV1251-001LF** Green™ Marking: EH		**SMV1251-004LF** Green™ Marking: EH3	**SMV1251-040LF** Marking: EH1
				SMV1253-004 Marking: AJ3	**SMV1253-040LF** Marking: 3
SMV1253-079LF Marking: Cathode	**SMV1253-011LF** Marking: EJ			**SMV1253-004LF** Green™ Marking: EJ3	
		SMV1255-001 Marking: AK1			**SMV1255-040LF** Marking: 4
♦ **SMV1255-079LF** Marking: Cathode	**SMV1255-011LF** Marking: EK	**SMV1255-001LF** Green™ Marking: EK1		**SMV1255-004LF** Green™ Marking: EK3	
Ls = 0.7 nH	Ls = 1.5 nH	Ls = 1.5 nH		Ls = 1.5 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 SMV1247-SMV1255 group of 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 SMV1247-SMV1255 varactors are illustrated in Figures 1 through 4.

The SPICE model for the SMV1247-SMV1255 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 SMV1247-SMV1255 group 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.

Table 2. SMV1247-SMV1255 Absolute Maximum Ratings

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:	ESD			
Charged Device Model (CDM), Class 4			1000	V
Human Body Model (HBM), Class 1A			250	V
Machine Model (MM), Class A			<50	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.

***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.*

Table 3. SMV1247-SMV1255 Electrical Specifications (Note 1)
(T_{OP} = 25 °C, Unless Otherwise Noted)

Part Number	C_T @ 0.3 V (pF)		C_T @ 4.7 V (pF)		C_T @ 1 V (pF)	C_T @ 3 V (pF)	$\frac{C_T \text{ @ 0.3 V}}{C_T \text{ @ 4.7 V}}$ (Ratio)		$\frac{C_T \text{ @ 1 V}}{C_T \text{ @ 3 V}}$ (Ratio)	R_S @ 3 V, 500 MHz (Ω)	Q @ 3 V, 50 MHz
	Min.	Typical	Typical	Max.	Typical	Typical	Min.	Typical	Typical	Max.	Typical
SMV1247	6.5	7	0.7	0.78	4.4	0.95	9.5	10.0	4.6	6.0	1500
SMV1248	15.0	17	1.5	1.70	12.3	2.60	10.8	12.0	4.7	3.3	700
SMV1249	28.0	31	2.6	2.80	18.2	3.40	11.0	12.1	5.3	2.2	600
SMV1251	38.0	42	3.4	3.80	28.1	5.80	11.0	12.2	4.8	1.6	400
SMV1253	48.0	53	4.3	4.80	37.0	7.80	11.0	12.3	4.7	1.4	350
SMV1255	58.0	64	5.2	5.80	43.3	8.50	11.0	12.3	5.1	1.3	350

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

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)					
	SMV1247	SMV1248	SMV1249	SMV1251	SMV1253	SMV1255
0	8.86	22.62	37.35	53.65	69.32	81.21
0.5	6.17	16.32	25.88	38.23	50.23	58.28
1.0	4.37	12.33	18.18	28.09	37.07	43.27
1.5	2.96	9.12	12.08	20.13	27.57	31.49
2.0	1.88	6.27	7.27	13.55	19.37	21.50
2.5	1.22	3.93	4.44	8.60	12.39	13.40
3.0	0.95	2.57	3.40	5.78	7.77	8.51
3.5	0.83	1.95	2.96	4.57	5.77	6.51
4.0	0.77	1.71	2.72	3.95	4.86	5.58
4.5	0.73	1.59	2.51	3.58	4.34	5.07
5.0	0.70	1.49	2.38	3.33	4.01	4.76
5.5	0.68	1.44	2.30	3.16	3.78	4.58
6.0	0.67	1.40	2.24	3.03	3.62	4.46
6.5	0.66	1.36	2.19	2.94	3.50	4.39
7.0	0.65	1.33	2.14	2.88	3.41	4.33
7.5	0.64	1.31	2.09	2.83	3.34	4.29
8.0	0.64	1.30	2.03	2.79	3.28	4.26

Typical Performance Characteristics

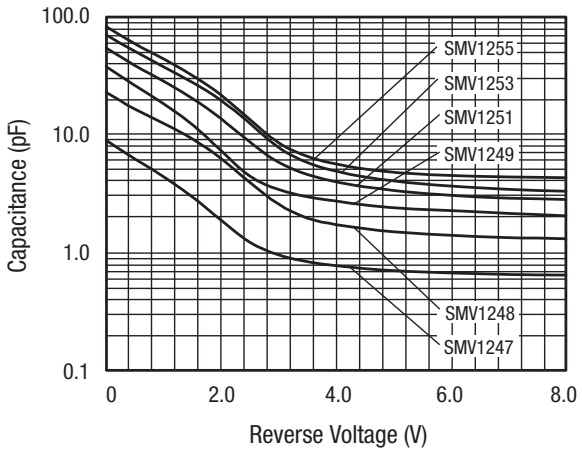


Figure 1. Capacitance vs Reverse Voltage

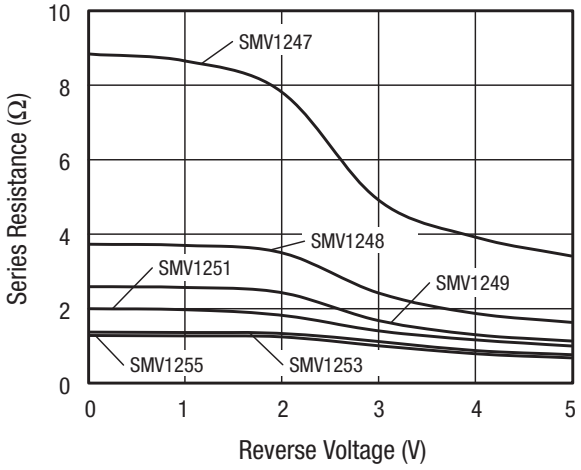


Figure 2. Series Resistance vs Reverse Voltage @ 500 MHz

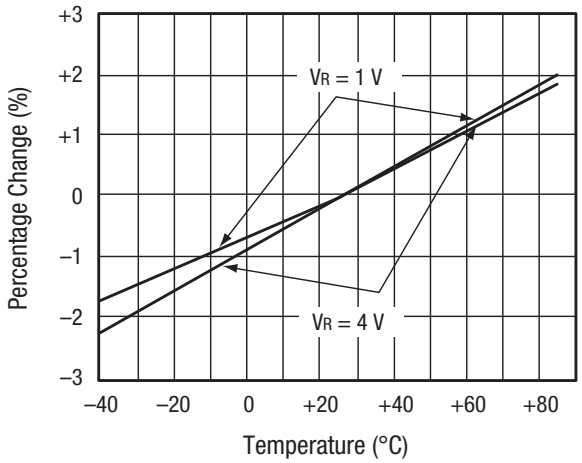


Figure 3. Relative Capacitance Change vs Temperature

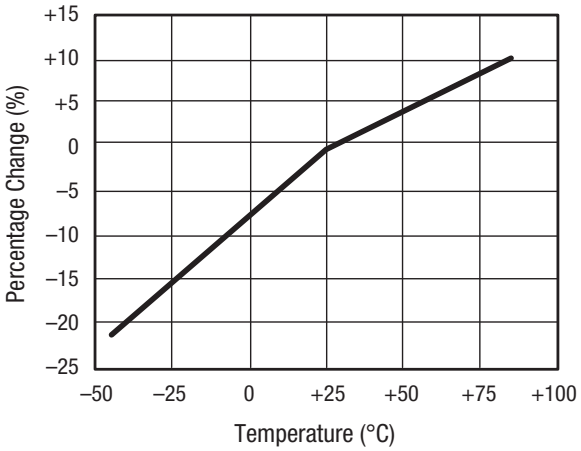


Figure 4. Relative Series Resistance Change vs Temperature @ 500 MHz

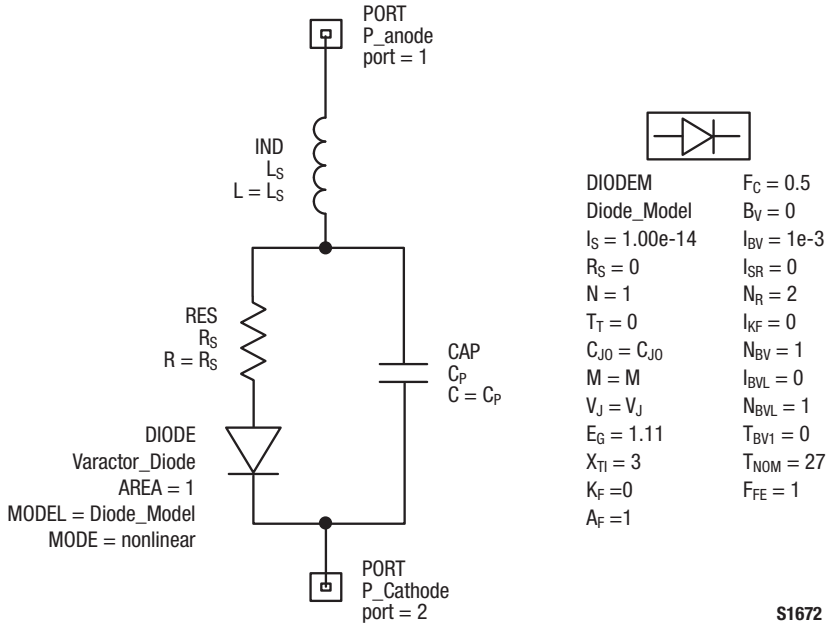


Figure 5. SPICE Model

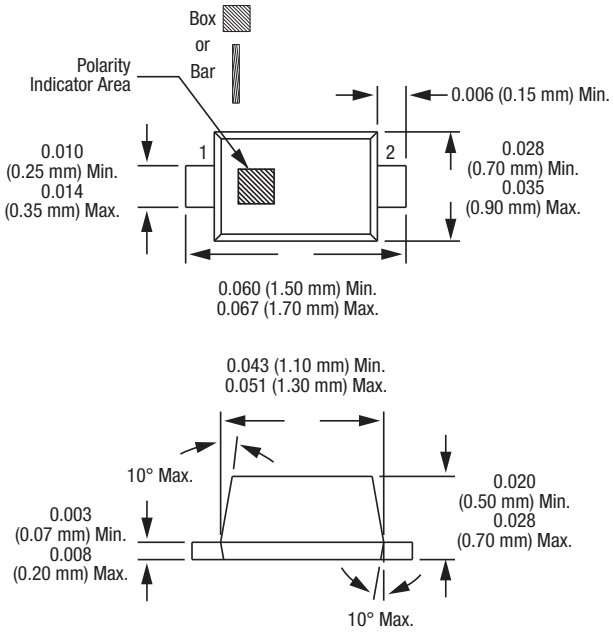
Table 5. SPICE Model Parameters

Part Number	C_{J0} (pF)	V_J (V)	M	C_P (pF)	R_S (Ω)
SMV1247	8.47	80	70	0.54	4.9
SMV1248	22.12	138	100	0.87	2.4
SMV1249	36.40	80	70	1.68	1.7
SMV1251	52.48	100	76	2.00	1.4
SMV1253	68.30	100	71	2.00	1.1
SMV1255	80.00	135	100	2.74	1.0

Model was designed to fit measured data in the range of up to 4 V.

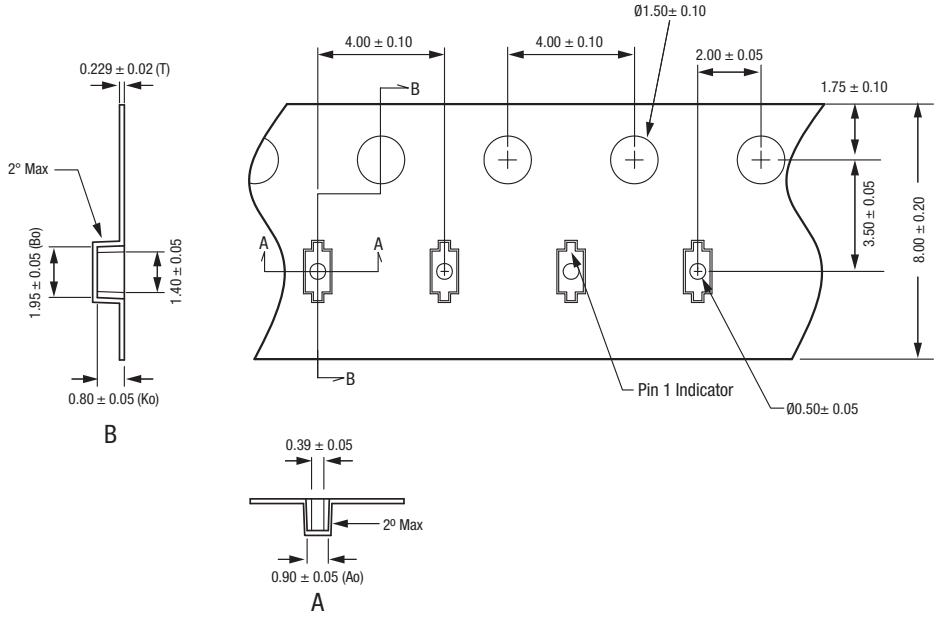
For package inductance (L_S), refer to Table 1.

For more details, refer to the Skyworks Application Note, *Varactor SPICE Model for Approved RF VCO Applications*, document number 200315.



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

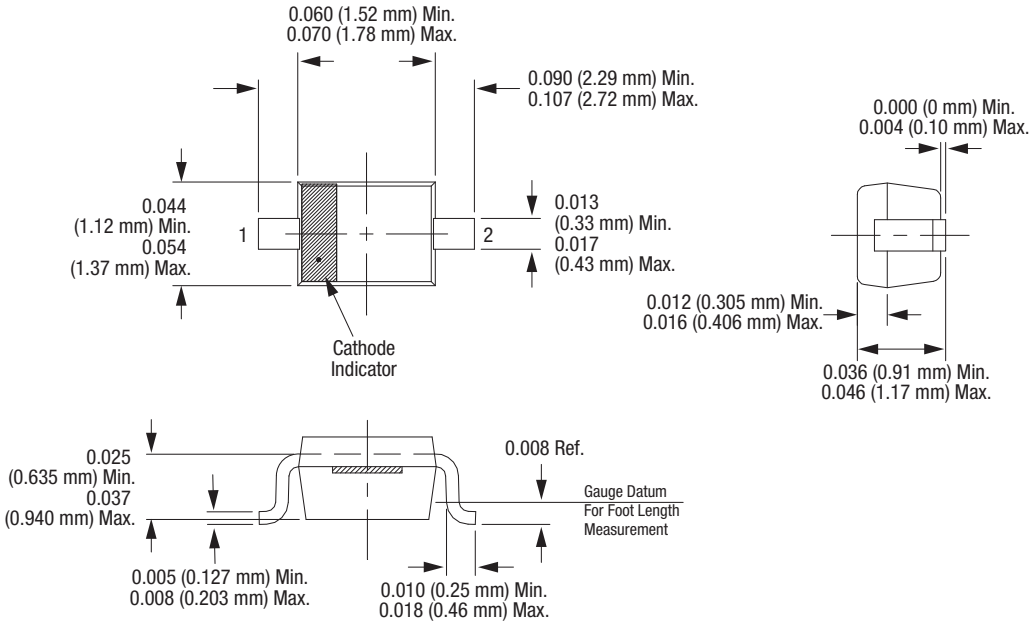
Figure 6. SC-79 Package Dimensions



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 ≤1 x 10^8 Ohms/square per EIA, JEDEC TNR Specification.*
4. *All measurements are in millimeters.*

S2929

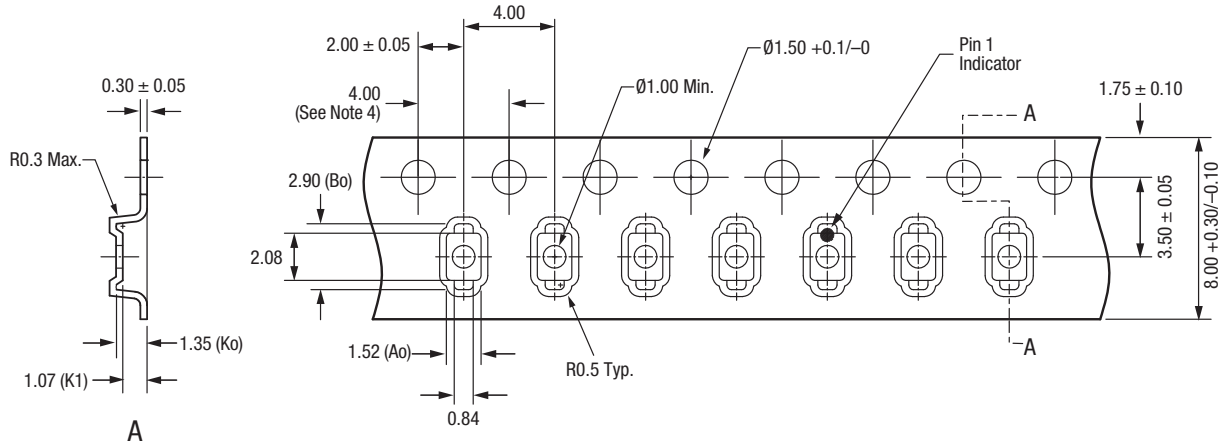
Figure 7. SC-79 Tape and Reel Dimensions



Dimensions are in inches (millimeters shown in parentheses)

S1619

Figure 8. 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 9. SOD-323 Tape and Reel Dimensions

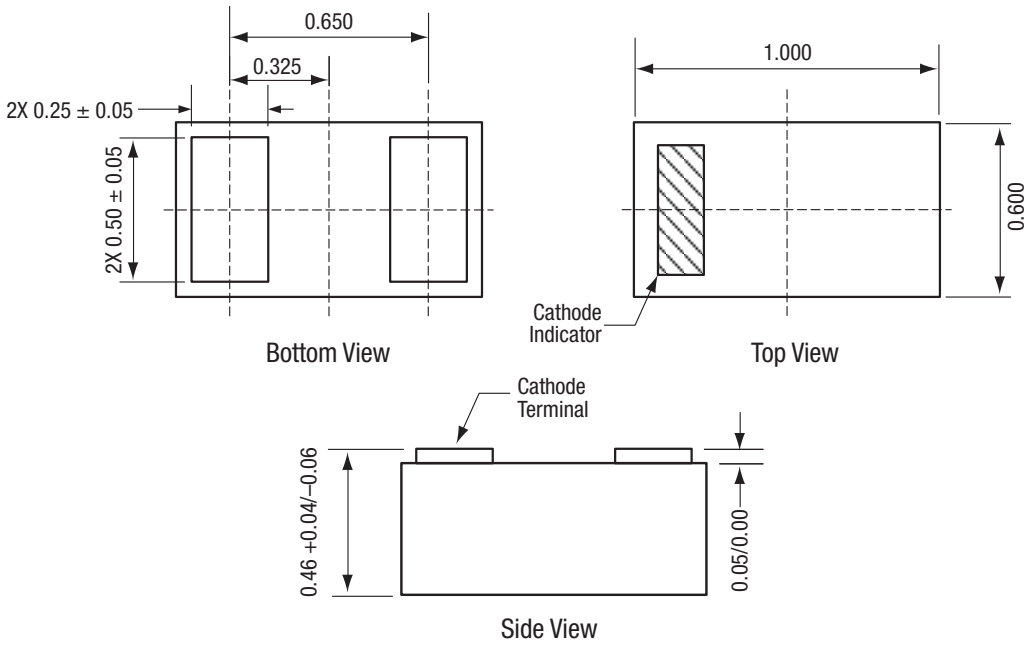
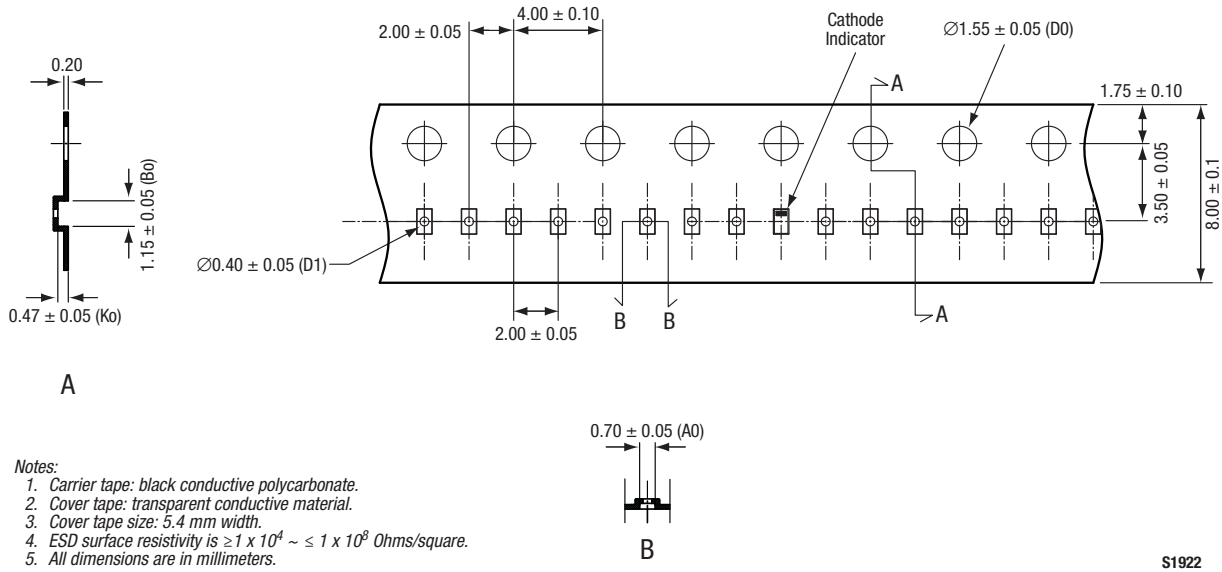
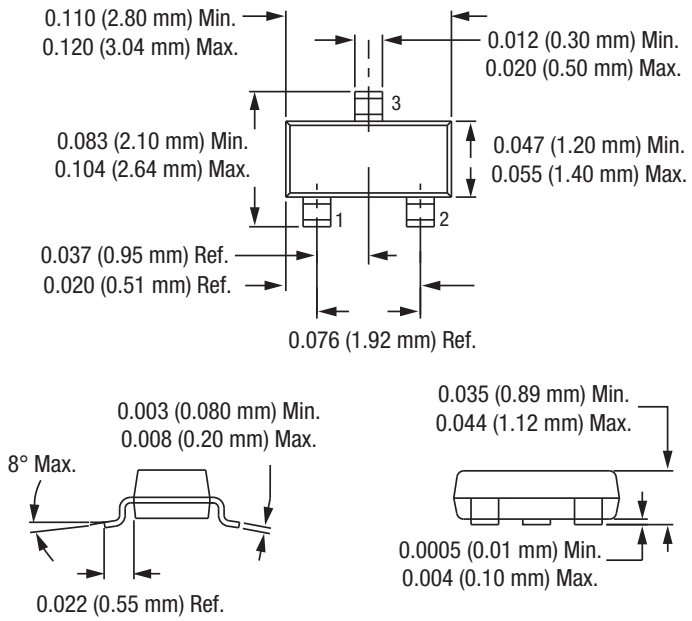


Figure 10. SOD-882 Package Dimensions



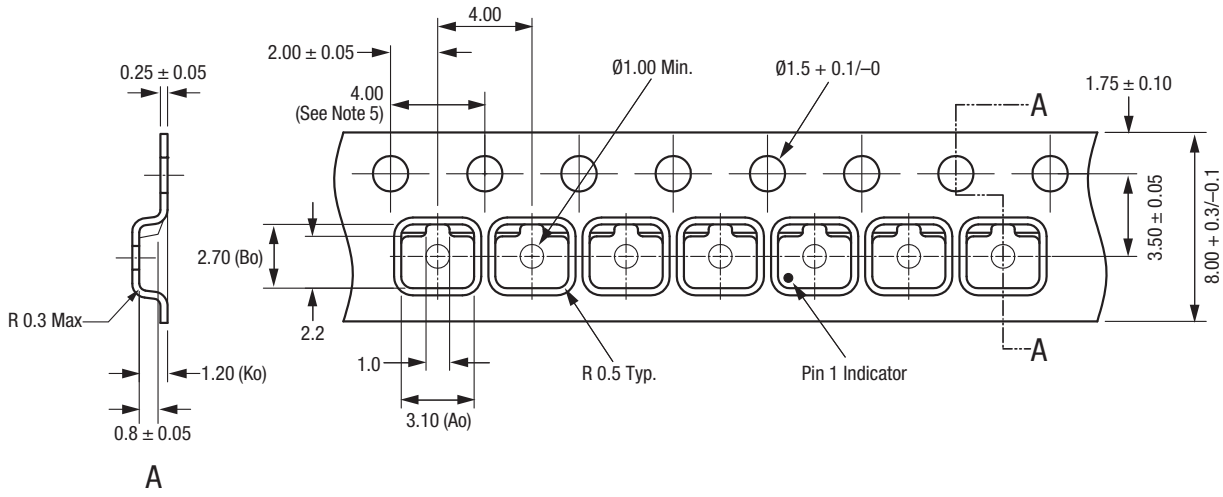
Notes:
1. *Carrier tape: black conductive polycarbonate.*
2. *Cover tape: transparent conductive material.*
3. *Cover tape size: 5.4 mm width.*
4. *ESD surface resistivity is ≥1 x 10^4 ~ ≤ 1 x 10^8 Ohms/square.*
5. *All dimensions are in millimeters.*

Figure 11. SOD-882 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. *Ten sprocket hole pitch cumulative tolerance: ±0.2 mm.*
6. *All measurements are in millimeters.*

S1684b

Figure 13. SOT-23 Tape and Reel Dimensions