DATA SHEET

SMV2019 to 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

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Description

The SMV2019 to 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 to SMV2023 series of varactors.

Table 1. Packaging and Marking

Common Cathode	Single	Single	Single
SOT-23	SOD-323 Green™	SC-79 Green™	SOD-882 Green™
		SMV2019-079LF Marking: Cathode and YX	**SMV2019-040LF** Marking: Z
		SMV2020-079LF Marking: Cathode and YY	
SMV2022-004LF Green™ Marking: DJ3			
	SMV2023-011LF Marking: DK		
L_S = 1.5 nH	L_S = 1.5 nH	L_S = 0.7 nH	L_S = 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.

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Electrical and Mechanical Specifications

The absolute maximum ratings of the SMV2019 to 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 to SMV2023 series.

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

Package Dimensions

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 to 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.

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Table 2. SMV2019 to SMV2023 Absolute Maximum Ratings[1]

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

[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.

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Table 3. SMV2019 to SMV2023 Electrical Specifications[1, 2]
(T_{OP} = 25 °C, Unless Otherwise Noted)

Part Number	C_T @ 4 V (pF)		C_T @ 20 V (pF)		$\frac{C_T \text{ @ 4 V}}{C_T \text{ @ 20 V}}$ Ratio	Q @ 4 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

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

2 Reverse current, I_R (V_R = 16 V): 50 nA maximum.

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Typical Performance Characteristics

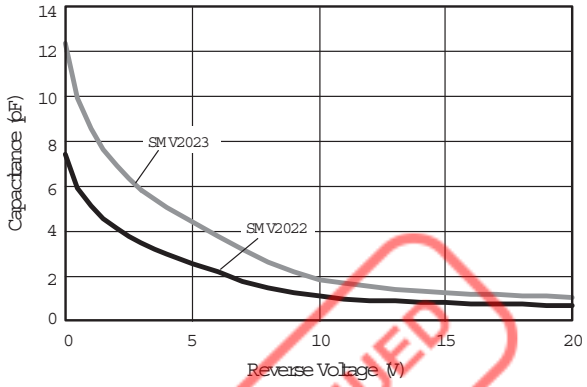

Figure 1. SMV2022 and SMV2023 Capacitance vs Reverse Voltage

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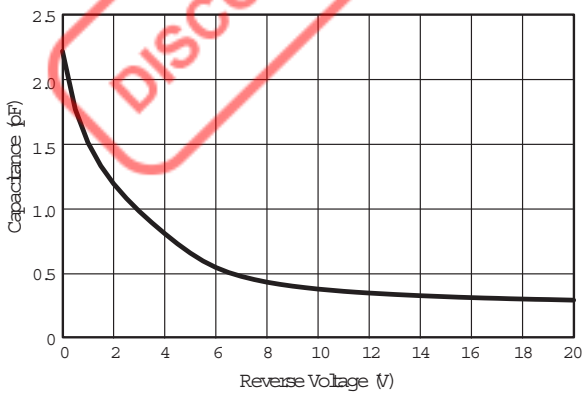

Figure 2. SMV2019-079LF Capacitance vs Reverse Voltage

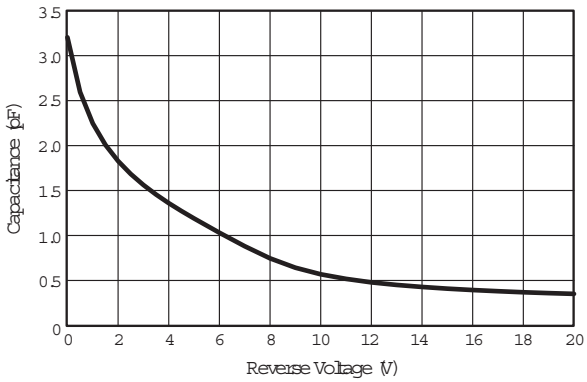

Figure 3. SMV2020-079LF Capacitance vs Reverse Voltage

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Table 4. Capacitance vs Reverse Voltage

V_R (V)	C_T (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

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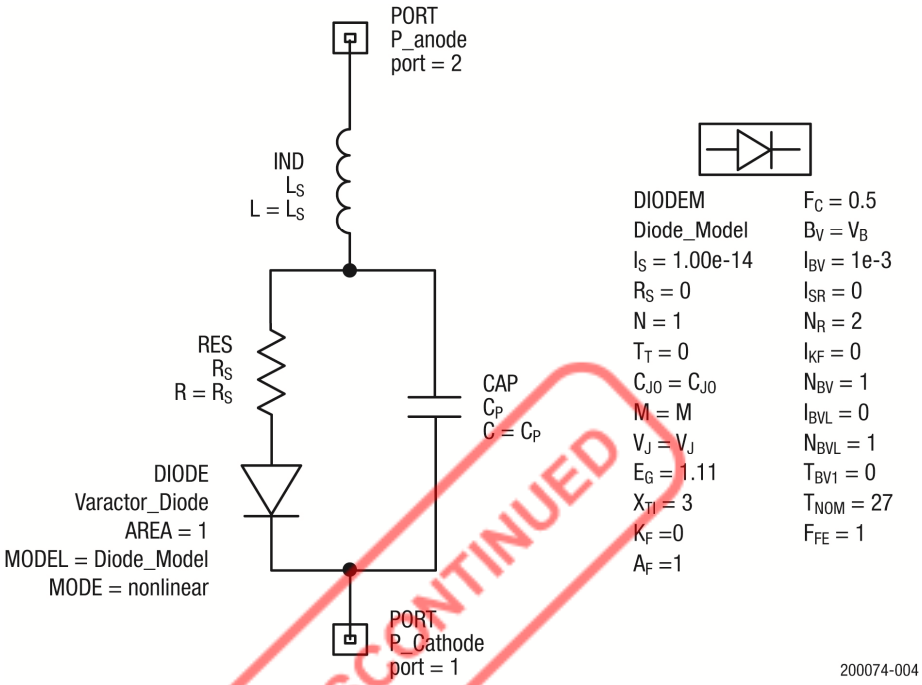

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Figure 4. SPICE Model

Table 5. SPICE Model Parameters

Part Number	C_{JO} (pF)	V_J (V)	M	C_P (pF)	R_S (Ω)	L_S (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
SMV2022-004LF	7.30	4.0	1.4	0	2.2	1.5
SMV2023-011LF	12.23	4.0	1.4	0	1.6	1.5

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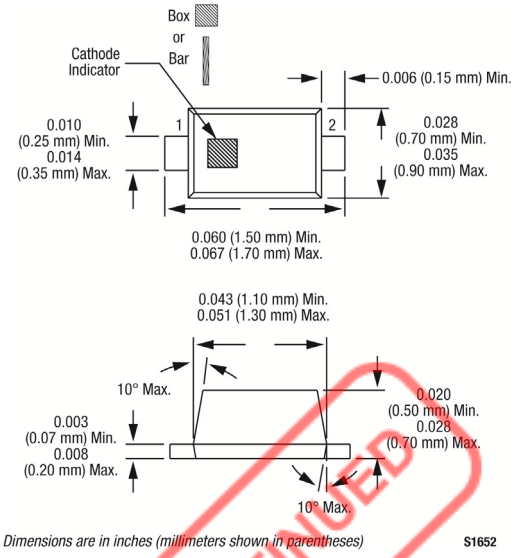
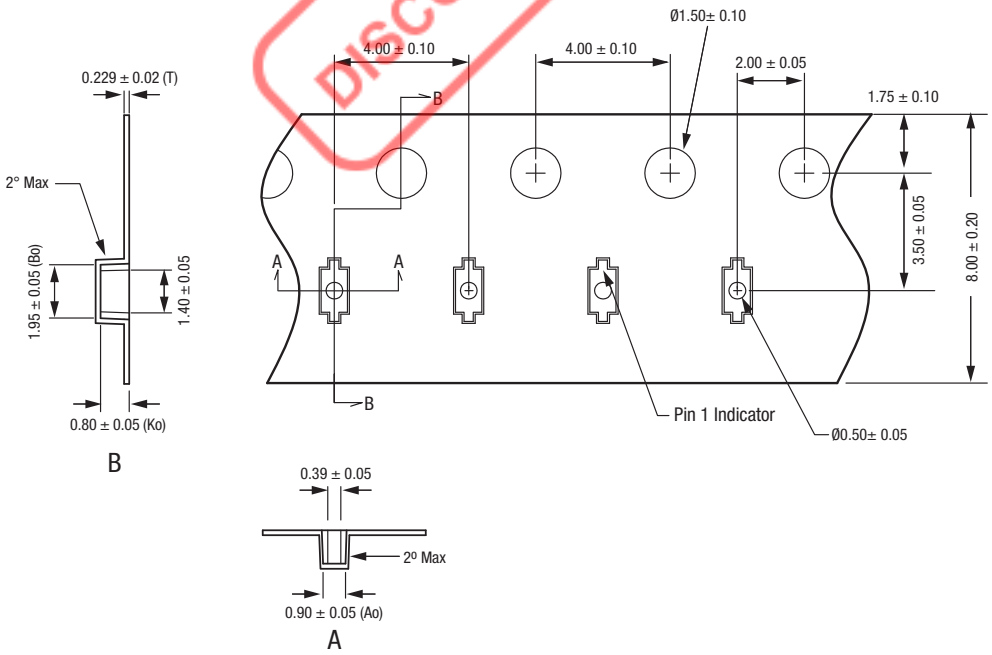


Figure 5. SC-79 Package Dimensions



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

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Figure 6. SC-79 Tape and Reel Dimensions

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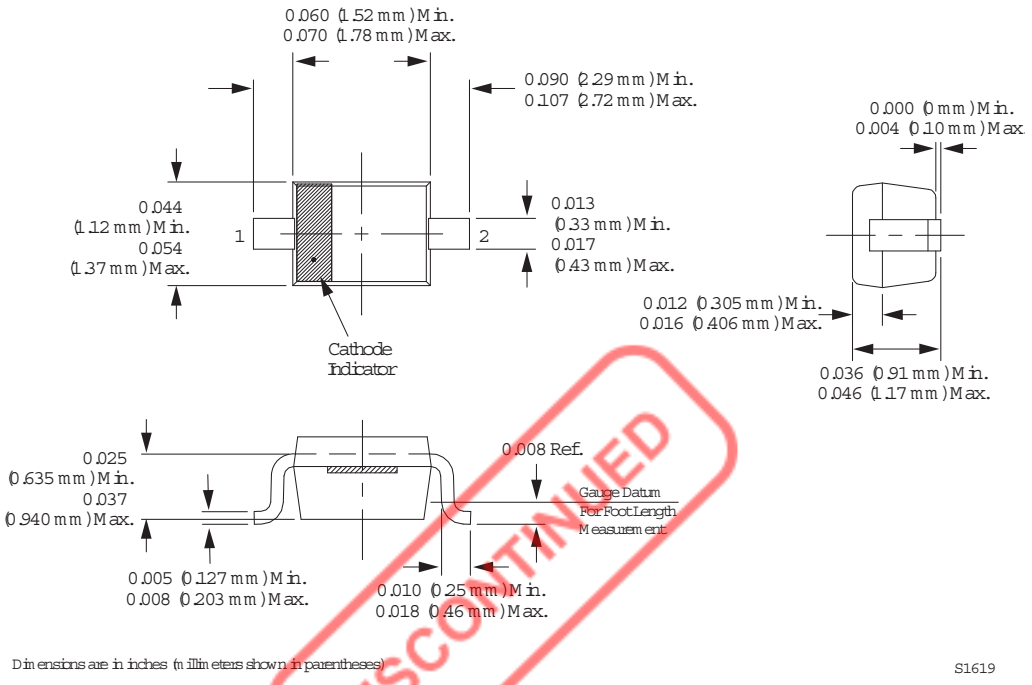

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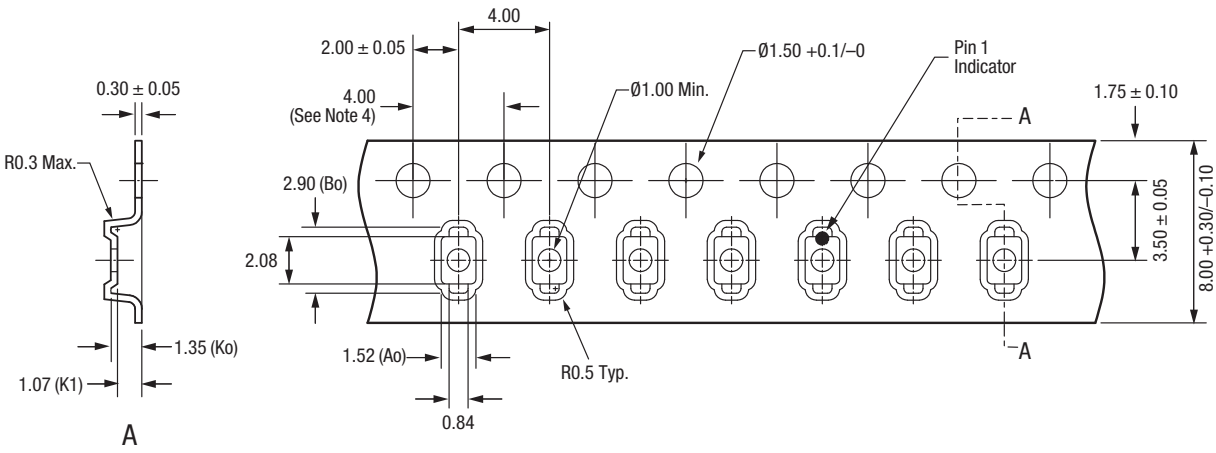
Figure 7. SOD-323 Package Dimensions



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.*

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Figure 8. SOD-323 Tape and Reel Dimensions

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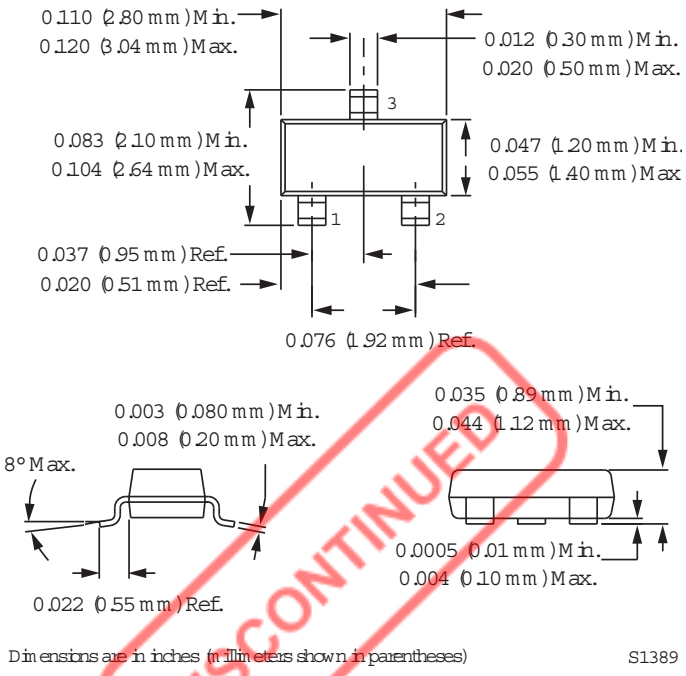

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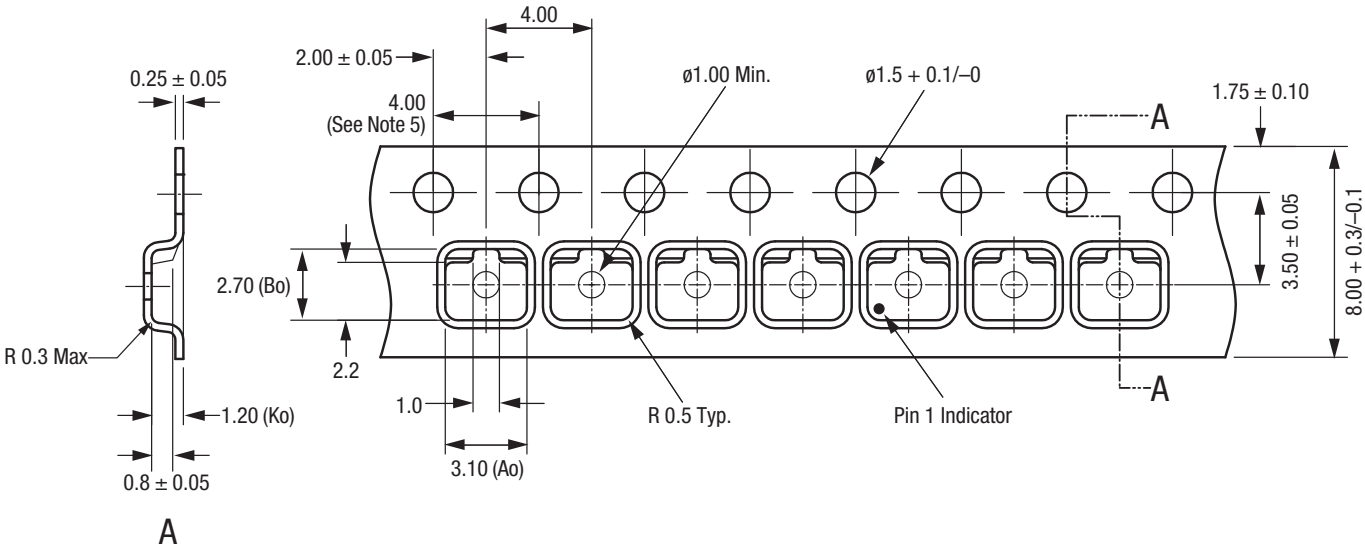
Figure 9. SOT-23 Package Dimensions



Notes:
1. *Carrier tape: black conductive polycarbonate.*
2. *Cover tape material: transparent conductive PSA.*
3. *Cover tape size: 5.40 mm width.*
4. *Tolerance ±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:*
   Ao = 3.3
   Bo = 2.9
   Ko = 1.22

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Figure 10. SOT-23 Tape and Reel Dimensions

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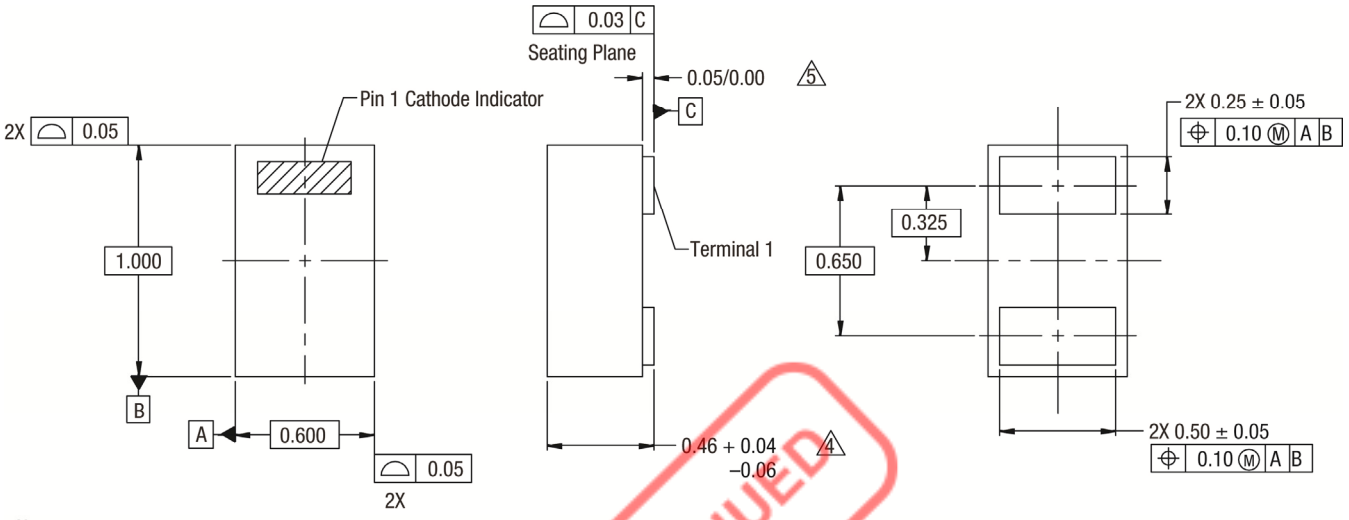

Notes:
1. *All measurements are in millimeters.*
2. *Dimensions and tolerances according to ASME Y14.5M-1994.*
3. *These packages are used principally for discrete devices.*
4. *This dimension includes stand-off height and package body thickness, but does not include attached features, e.g., external 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.*

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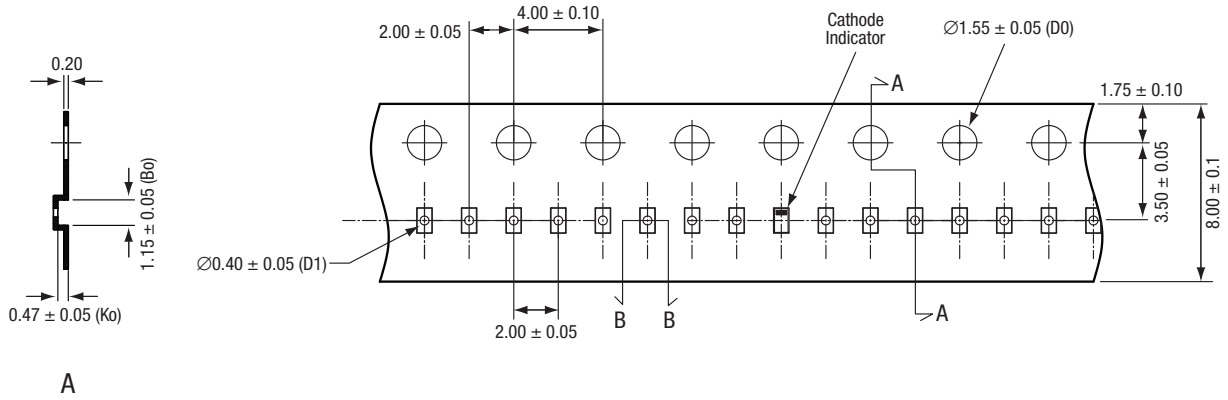
Figure 11. SOD-882 Package Dimensions



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 ≥1 x 10^4 ~ ≤ 1 x 10^8 Ohms/square.*
5. *All dimensions are in millimeters.*

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Figure 12. SOD-882 Tape and Reel Dimensions

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