

DATA SHEET

# SMV121x Series: Hyperabrupt Junction Tuning Varactors

## Applications

- Low tuning voltage VCOs
- High-volume commercial systems

## Features

- High capacitance ratio:  $C_{1V}/C_{4V} = 5$  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 SMV121x series of silicon hyperabrupt junction varactor diodes are designed for use in Voltage Controlled Oscillators (VCOs) with a low tuning voltage operation. This family of varactors is characterized for capacitance and resistance over temperature.

Table 1 describes the various packages and markings of the SMV121x varactors.

**Table 1. Packaging and Marking**

			
Single	Single	Common Cathode	Single
SC-79 Green™	SOT-23	SOT-23	SOD-882 Green™
<b>SMV1212-079LF</b> Marking: Cathode and HA	<b>SMV1212-001LF</b> Green™ Marking: EB1		
<b>SMV1213-079LF</b> Marking: Cathode and HC	◆ <b>SMV1213-001LF</b> Green™ Marking: D86	<b>SMV1213-004LF</b> Green™ Marking: GD3	<b>SMV1213-004LF</b> Marking: J
	<b>SMV1215-001LF</b> Green™ Marking: DM1		
Ls = 0.7 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 SMV121x 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 SMV121x varactors are illustrated in Figures 1 through 4.

The SPICE model for the SMV121x varactors is shown in Figure 5 and the associated model parameters are provided in Table 6.

## Package Dimensions

Package dimensions are shown in Figures 6 to 10 (even numbers), and tape and reel dimensions are provided in Figures 7 to 11 (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.

**Table 2. SMV121x Varactors Absolute Maximum Ratings<sup>1</sup>**

Parameter	Symbol	Minimum	Maximum	Units
Reverse voltage	$V_R$		12	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 3			1000	V
Human Body Model (HBM), Class 1B			500	V
Machine Model (MM), Class A			100	V

<sup>1</sup> 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. SMV121x Varactors Electrical Specifications<sup>1</sup>****( $T_{OP} = 25^\circ\text{C}$ , Unless Otherwise Noted)**

Part Number	C <sub>T</sub> @ 1 V (pF)		C <sub>T</sub> @ 2.5 V (pF)		C <sub>T</sub> @ 4 V (pF)		$\frac{C_T @ 1 V}{C_T @ 2.5 V}$ (Ratio)	$\frac{C_T @ 1 V}{C_T @ 4 V}$ (Ratio)	R <sub>s</sub> @ 4 V, 500 MHz (Ω)
	Min	Typ	Min	Max	Typ	Max	Typ	Typ	Typ
SMV1212	42.0	50.0	18.0	27.0	9	12.0	2	5	0.8
SMV1213	17.0	22.0	8.5	10.5	4	5.5	2	5	1.4
SMV1214	14.5	16.0	6.5	7.8	3	4.8	2	5	1.7
SMV1215	8.7	9.5	4.3	5.5	2	2.9	2	5	2.8

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.

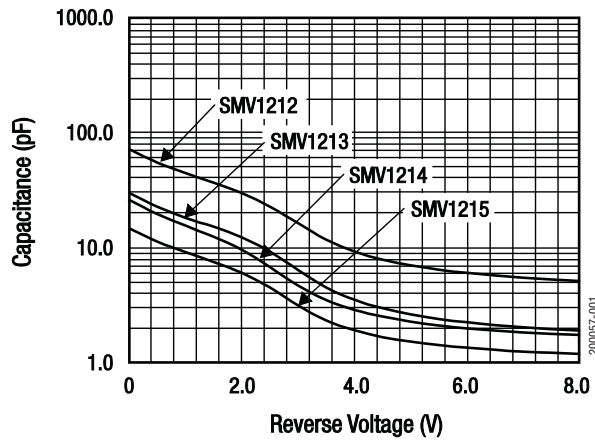
Reverse voltage  $V_R$  ( $I_R = 10\ \mu\text{A}$ ) = 12 V minimum

Reverse current  $I_R$  ( $V_R = 8\ \text{V}$ ) = 20 nA maximum

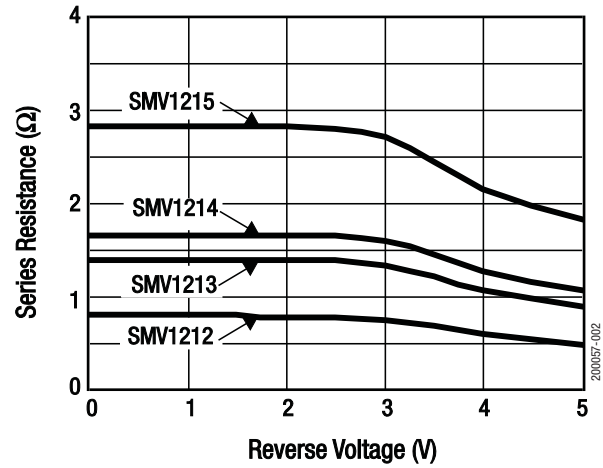
**Table 4. Typical Capacitance Values**

V <sub>R</sub> (V)	C <sub>T</sub> (pF)			
	SMV1212	SMV1213	SMV1214	SMV1215
0	72.4	30.0	26.0	14.8
0.5	55.3	22.8	19.6	11.3
1.0	44.9	18.1	15.6	9.1
1.5	36.9	15.3	12.4	7.5
2.0	29.9	12.3	9.6	6.0
2.5	22.9	9.2	6.8	4.5
3.0	16.3	6.4	4.7	3.1
3.5	11.8	4.5	3.5	2.3
4.0	9.3	3.5	2.9	1.9
4.5	7.9	3.0	2.5	1.7
5.0	7.0	2.6	2.3	1.5
5.5	6.4	2.4	2.1	1.4
6.0	6.0	2.2	2.0	1.3
6.5	5.7	2.1	1.9	1.3
7.0	5.5	2.0	1.8	1.2
7.5	5.3	1.9	1.8	1.2
8.0	5.1	1.9	1.7	1.2

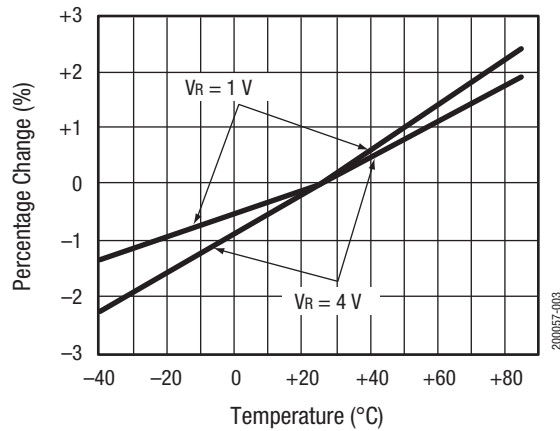
## Typical Performance Characteristics



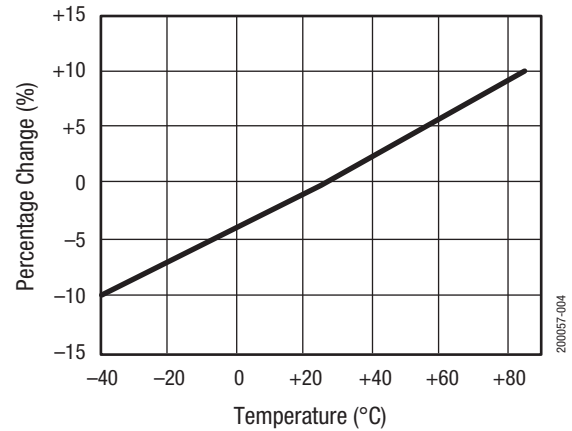
**Figure 1. Capacitance vs Reverse Voltage**



**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**

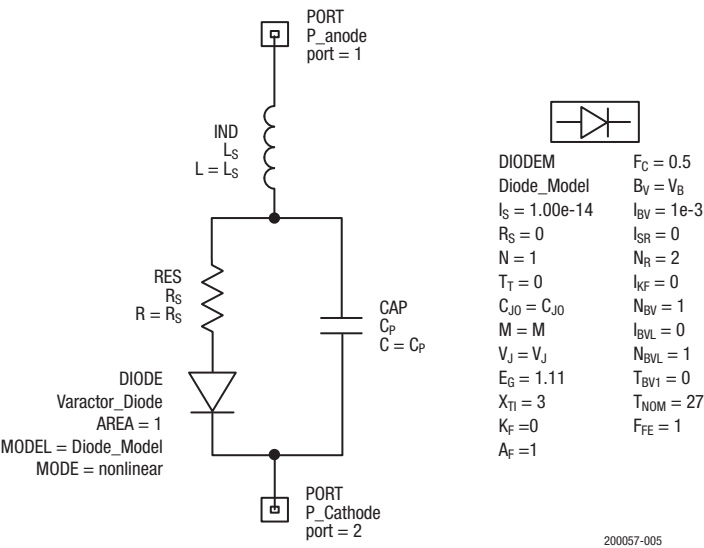
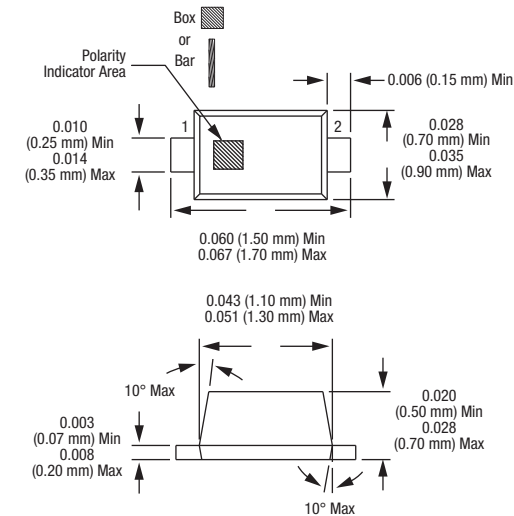


Figure 5. SPICE Model

Table 5. SPICE Model Parameters<sup>1</sup>

Part Number	Cj0 (pF)	Vj (V)	M	Cp (pF)	Rs (Ω)
SMV1212	72.47	110	67	4.5	0.8
SMV1213	28.90	190	105	2.2	1.4
SMV1214	22.74	190	106	1.5	1.7
SMV1215	14.36	190	115	1.1	2.8

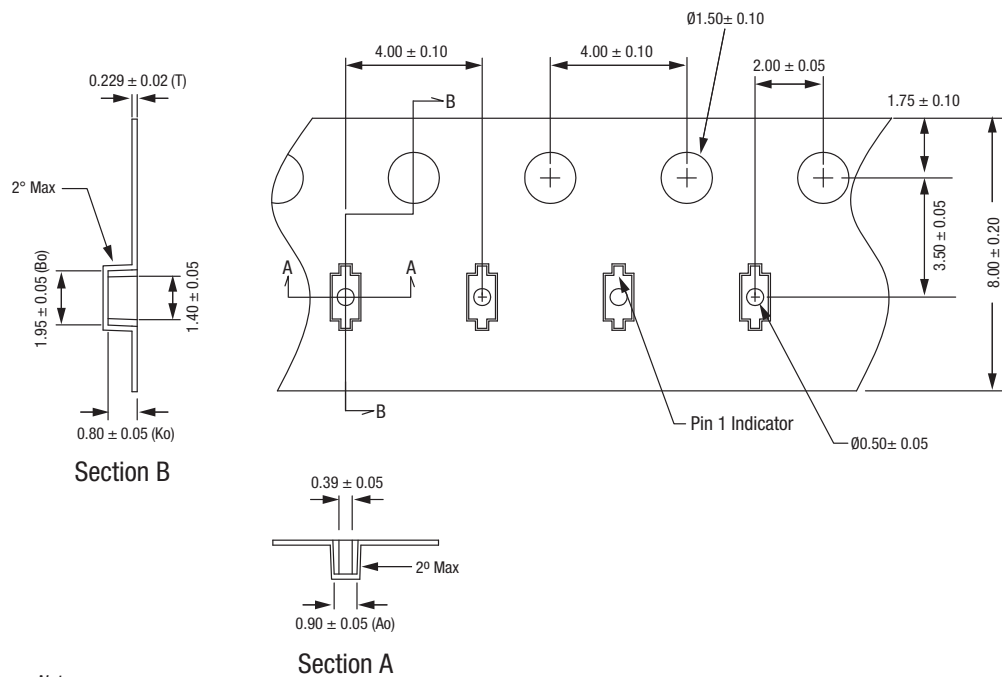
<sup>1</sup> Values extracted from measured performance.  
For package inductance (Ls, refer to Table 1.  
For more details, refer to the Skyworks Application Note, *Varactor SPICE Model for Approved RF VCO Applications*, document number 200315.



Dimensions are in inches (millimeters shown in parentheses)

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**Figure 6. SC-79 Package Dimensions**

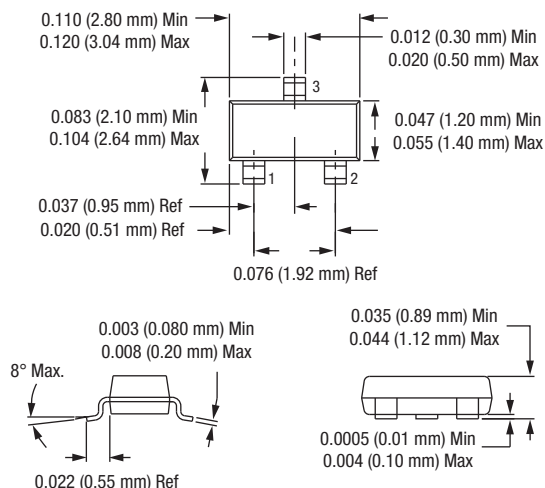


Notes:

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

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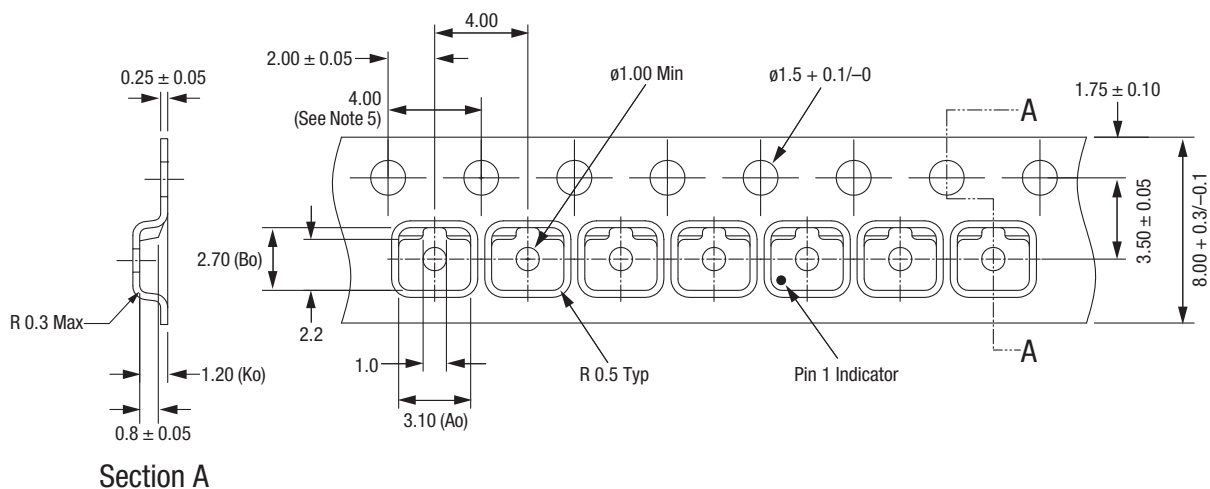
**Figure 7. SC-79 Tape and Reel Dimensions**



Dimensions are in inches (millimeters shown in parentheses)

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**Figure 8. SOT-23 Package Dimensions**



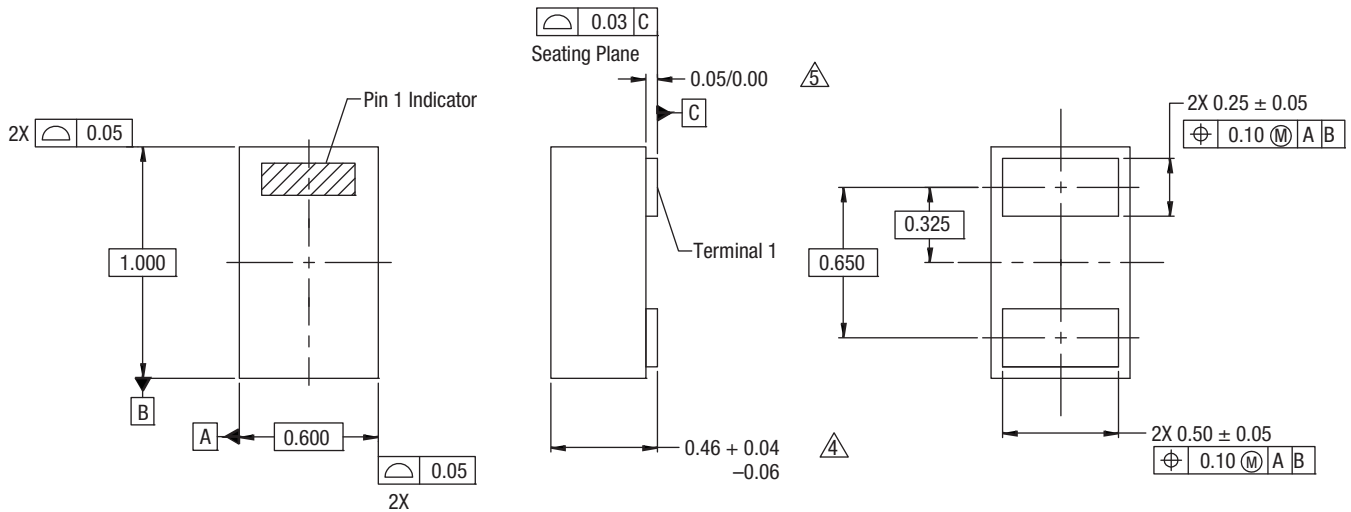
Notes:

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 9. SOT-23 Tape and Reel Dimensions**



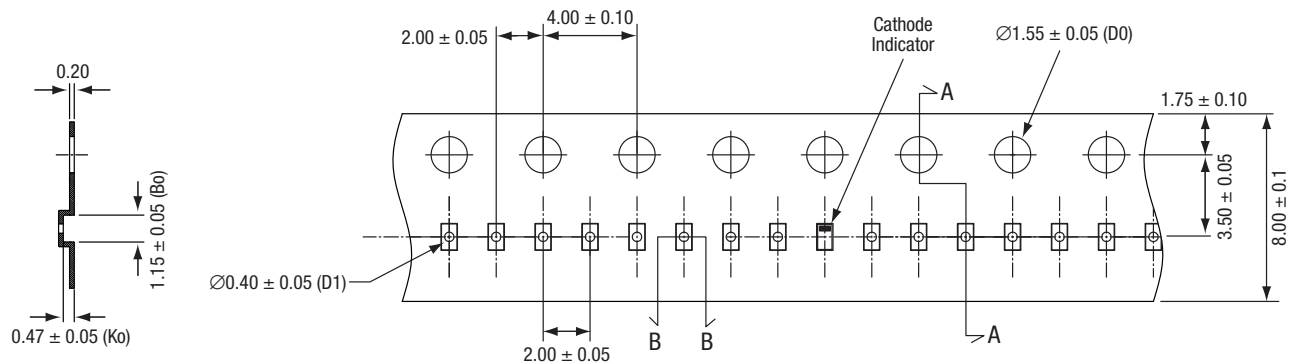


## Notes:

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.

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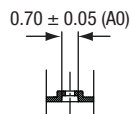
Figure 10. SOD-882 Package Dimensions



## 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  $\geq 1 \times 10^4 \sim \leq 1 \times 10^8$  Ohms/square.
5. All dimensions are in millimeters.



## Section B

200057-011

Figure 11. SOD-882 Tape and Reel Dimensions

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