

DATA SHEET

# SMV1211–SMV1215: Hyperabrupt Junction Tuning Varactors

## Features

- High capacitance ratio,  $C_{1V}/C_{4V} = 5$  typ.
- Multiple packages SOT-23, SOD-323, SC-70 and SC-79
- Designed for high volume commercial applications
- SPICE models are available

## Description

The SMV1211–SMV1215 series of silicon hyperabrupt junction varactor diodes is designed for use in VCOs with low tuning voltage operation. This family of varactors is characterized for capacitance and resistance over temperature. SPICE models are provided.

**NEW** Skyworks offers lead (Pb)-free “environmentally friendly” packaging that is RoHS compliant (European Parliament for the Restriction of Hazardous Substances).








## Absolute Maximum Ratings


Characteristic	Value
Reverse voltage ( $V_R$ )	12 V
Forward current ( $I_F$ )	20 mA
Power dissipation ( $P_D$ )	250 mW
Storage temperature ( $T_{ST}$ )	-55 °C to +150 °C
Operating temperature ( $T_{OP}$ )	-55 °C to +125 °C
ESD human body model	Class 0

Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void the warranty.

**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 must be employed at all times.

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Single	Single	Single	Common Cathode	Common Cathode
SC-79	SOD-323	SOT-23	SOT-23	SC-70
		<b>SMV1211-001</b>		
		Marking: AA1		
<b>SMV1212-079</b>		<b>SMV1212-001</b>	<b>SMV1212-004</b>	<b>SMV1212-074</b>
Marking: Cathode		Marking: AB1	Marking: AB3	Marking: AB3
		<b>SMV1212-001LF</b>		
		Marking: EB1		
<b>SMV1213-079</b>		<b>SMV1213-001</b>	<b>SMV1213-004</b>	<b>SMV1213-074</b>
Marking: Cathode		Marking: 86	Marking: BD3	Marking: BD3
<b>SMV1213-079LF</b>		<b>SMV1213-001LF</b>	<b>SMV1213-004LF</b>	
Marking: Cathode		Marking: D86	Marking: GD3	
		<b>SMV1214-001</b>		
		Marking: VL1		
	<b>SMV1215-011</b>	<b>SMV1215-001</b>	<b>SMV1215-004</b>	
	Marking: VM	Marking: VM1		
$L_S = 0.7 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.4 \text{ nH}$	$L_S = 1.4 \text{ nH}$

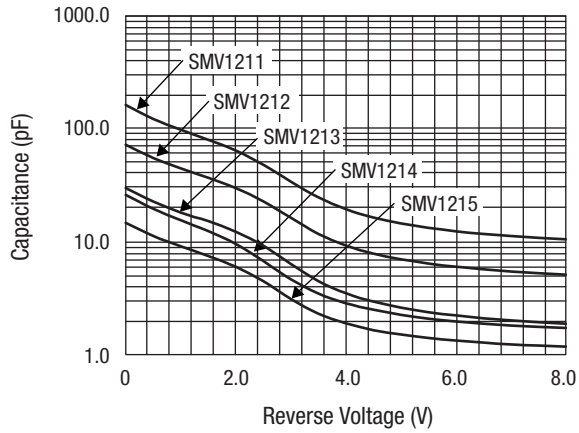
 LF denotes lead (Pb)-free packaging option as an alternative to our standard tin/lead (Sn/Pb) packaging.

**Electrical Specifications at 25 °C**

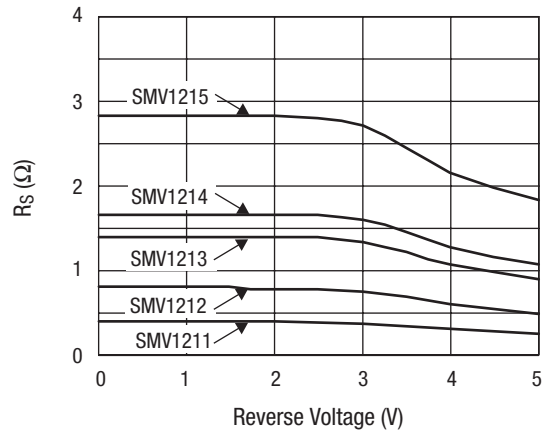
Part Number	$C_T @ 1 \text{ V}$ (pF)		$C_T @ 2.5 \text{ V}$ (pF)		$C_T @ 4 \text{ V}$ (pF)		$\frac{C_T @ 1 \text{ V}}{C_T @ 2.5 \text{ V}}$ (Ratio)	$\frac{C_T @ 1 \text{ V}}{C_T @ 4 \text{ V}}$ (Ratio)	$R_S @ 4 \text{ V}$ 500 MHz ( $\Omega$ )	$Q @ 4 \text{ V}$ 50 MHz
	Min.	Typ.	Min.	Max.	Typ.	Max.	Typ.	Typ.	Typ.	Min.
SMV1211	95.0	100.0	40.0	65.0	20	25.0	2	5	0.4	80
SMV1212	42.0	50.0	18.0	27.0	9	12.0	2	5	0.8	150
SMV1213	17.0	22.0	8.5	10.5	4	5.5	2	5	1.4	200
SMV1214	14.5	16.0	6.5	7.8	3	4.8	2	5	1.7	300
SMV1215	8.7	9.5	4.3	5.5	2	2.9	2	5	2.8	350

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.

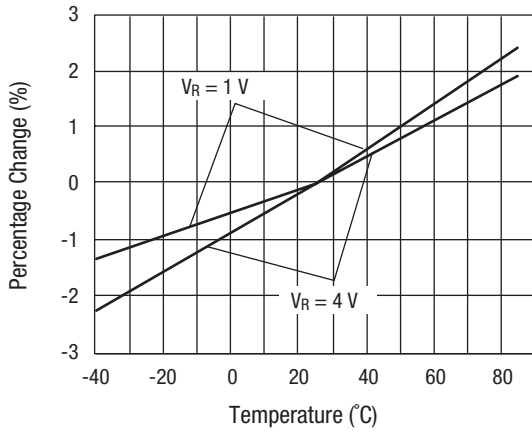
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**Typical Performance Data**



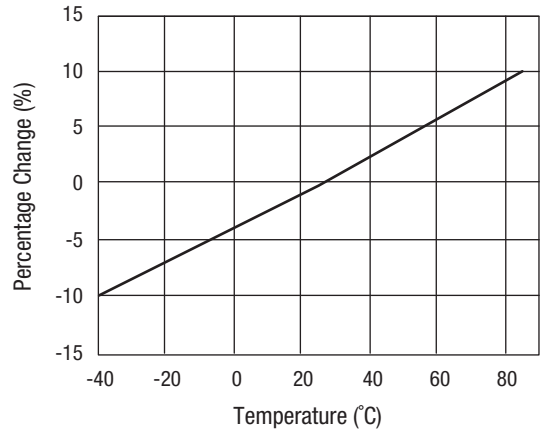
**Capacitance vs. Reverse Voltage**



**Series Resistance vs. Reverse Voltage @ 500 MHz**



**Relative Capacitance Change vs. Temperature**



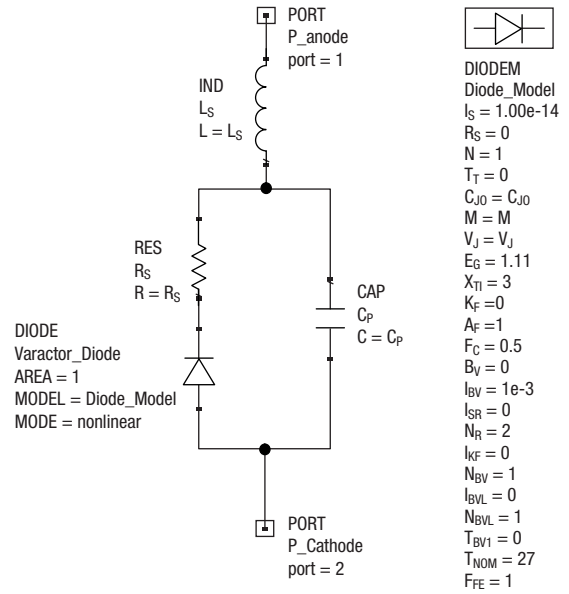
**Relative Series Resistance Change vs. Temperature @ 500 MHz**

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**Typical Capacitance Values**

$V_R$ (V)	SMV1211	SMV1212	SMV1213	SMV1214	SMV1215
	$C_T$ (pF)	$C_T$ (pF)	$C_T$ (pF)	$C_T$ (pF)	$C_T$ (pF)
0.0	162.6	72.4	30.0	26.0	14.8
0.5	122.3	55.3	22.8	19.6	11.3
1.0	98.6	44.9	18.1	15.6	9.1
1.5	80.4	36.9	15.3	12.4	7.5
2.0	64.2	29.9	12.3	9.6	6.0
2.5	48.2	22.9	9.2	6.8	4.5
3.0	34.1	16.3	6.4	4.7	3.1
3.5	24.7	11.8	4.5	3.5	2.3
4.0	19.4	9.3	3.5	2.9	1.9
4.5	16.4	7.9	3.0	2.5	1.7
5.0	14.6	7.0	2.6	2.3	1.5
5.5	13.3	6.4	2.4	2.1	1.4
6.0	12.4	6.0	2.2	2.0	1.3
6.5	11.7	5.7	2.1	1.9	1.3
7.0	11.2	5.5	2.0	1.8	1.2
7.5	10.8	5.3	1.9	1.8	1.2
8.0	10.5	5.1	1.9	1.7	1.2

**SPICE Model**



Part Number	$C_{JO}$ (pF)	$V_J$ (V)	M	$C_P$ (pF)	$R_S$ ( $\Omega$ )
SMV1211	163.00	200	130	9.5	0.4
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

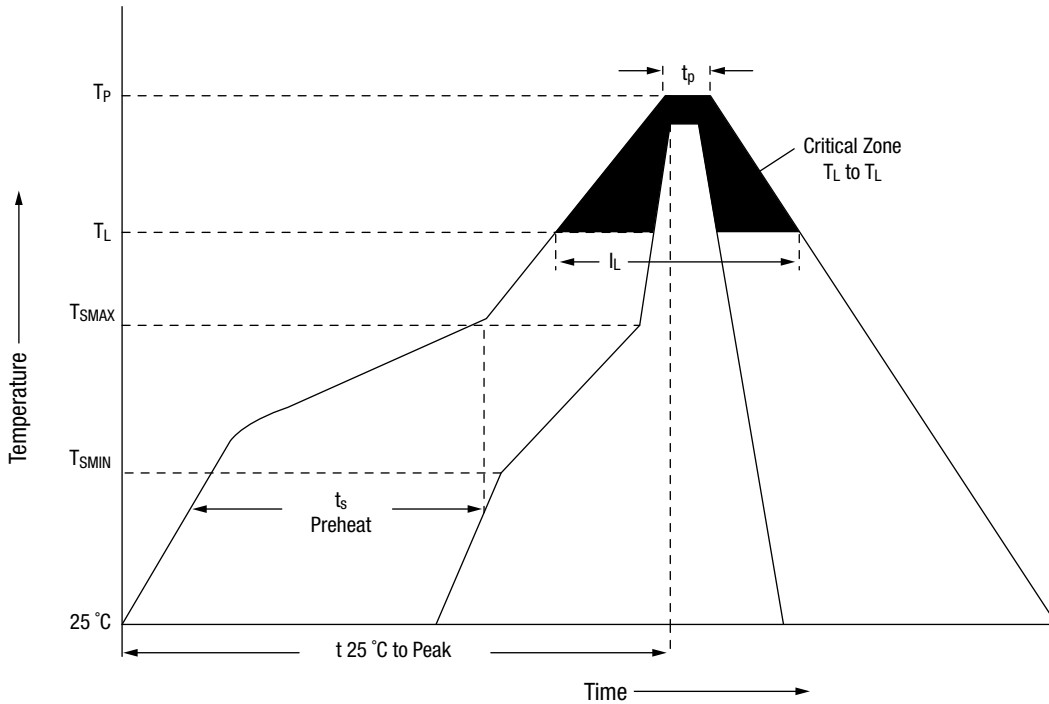
1. Values extracted from measured performance.
2. For package inductance ( $L_S$ ) refer to package type.
3. For more details refer to the "Varactor SPICE Models for RF VCO Applications" Application Note.

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**Recommended Solder Reflow Profiles**

Profile Feature	SnPb Eutectic Assembly	Lead (Pb)-Free Assembly 100% Sn
Average ramp-up rate ( $T_L$ to $T_P$ )	3 °C/second max.	3 °C/second max.
Preheat Temperature min. ( $T_{SMIN}$ ) Temperature max. ( $T_{SMAX}$ ) Time (min. to max.) ( $t_s$ )	100 °C 150 °C 60–120 seconds	150 °C 200 °C 60–80 seconds
$T_{SMAX}$ to $T_L$ Ramp-up rate	—	3 °C/second max.
Time maintained above: Temperature ( $T_L$ ) Time ( $t_L$ )	183 °C 60–150 seconds	217 °C 60–150 seconds
Peak temperature ( $T_P$ )	240 +0/-5 °C	250 +0/-5 °C
Time within 5 °C of actual peak temperature ( $t_p$ )	10–30 seconds	20–40 seconds
Ramp-down rate	6 °C/second max.	6 °C/second max.
Time 25 °C to peak temperature	6 minutes max.	8 minutes max.

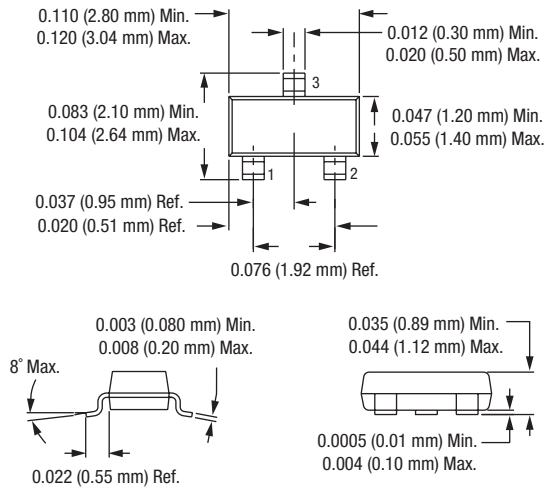
All temperatures refer to the top side of the package, measured on the package body surface.  
Reference JEDEC J-STD-020B.



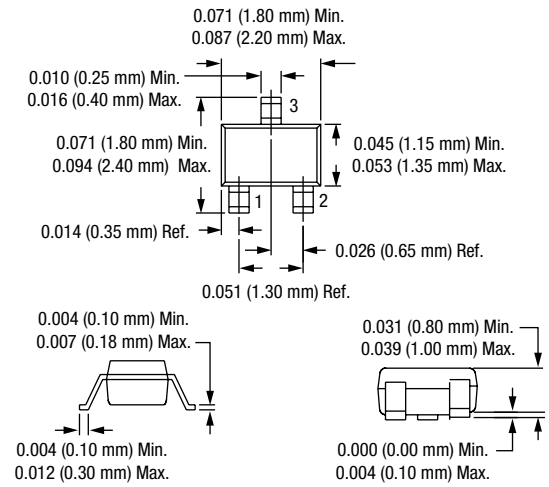
Reference JEDEC J-STD-020

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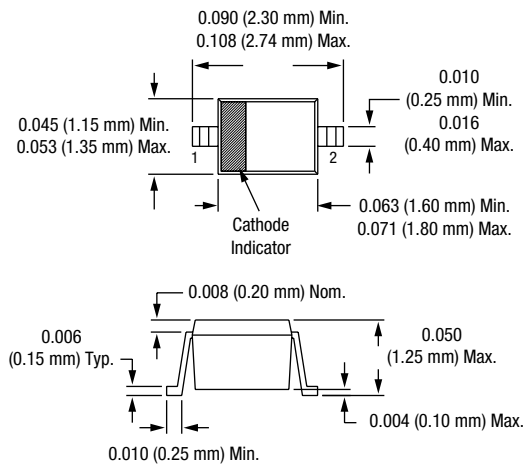
**SOT-23**



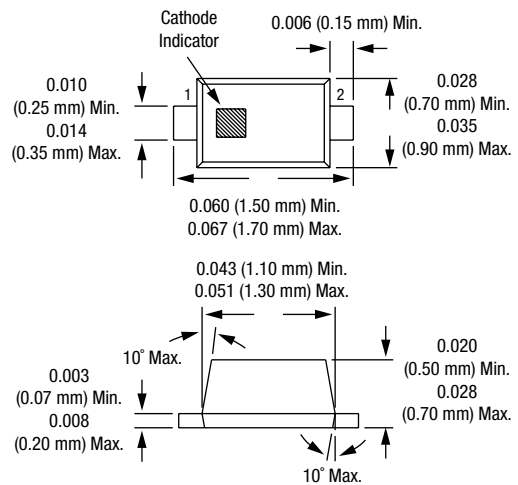
**SC-70**



**SOD-323**



**SC-79**



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