

DATA SHEET

SMV1232–SMV1237: Hyperabrupt Tuning Varactors

Features

- High capacitance ratio, $C_1/V/C_3V = 1.8$, $C_1/V/C_6V = 3.1$
- Low series resistance for low phase noise
- Multiple packages SOT-23, SOD-323, SC-70 and SC-79
- Designed for high volume commercial applications
- Full characterization with SPICE models

Description

The SMV1232–SMV1237 series of silicon hyperabrupt junction varactor diodes is designed for use in VCOs with low tuning voltage operation. The low resistance of these varactors makes them appropriate for high Q resonators in wireless system VCOs to frequencies beyond 2.5 GHz. The SMV1232–SMV1237 series is fully characterized for capacitance and resistance over temperature. SPICE model is 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)	15 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 1B

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.

Single	Single	Single	Common Anode	Common Cathode	Common Anode	Common Cathode
SC-79	SOD-323	SOT-23	SOT-23	SOT-23	SC-70	SC-70
SMV1232-079	SMV1232-011			SMV1232-004		SMV1232-074
Marking: Cathode	Marking: CC					Marking: CC3
						SMV1232-074LF
						Marking: DP3
SMV1233-079	SMV1233-011	SMV1233-001	SMV1233-003	SMV1233-004	SMV1233-073	SMV1233-074
Marking: Cathode	Marking: VP	Marking: VP1	Marking: VP9	Marking: VP3	Marking: VP9	Marking: VP3
	SMV1233-011LF					
	Marking: DP					
SMV1234-079	SMV1234-011	SMV1234-001	SMV1234-003	SMV1234-004	SMV1234-073	SMV1234-074
Marking: Cathode	Marking: VQ	Marking: VQ1	Marking: VQ9	Marking: VQ3	Marking: VQ9	Marking: VQ3
SMV1234-079LF	SMV1234-011LF					
Marking: Cathode	Marking: DQ					
SMV1235-079	SMV1235-011	SMV1235-001		SMV1235-004		SMV1235-074
Marking: Cathode	Marking: VR	Marking: VR1		Marking: VR3		Marking: VR3
				SMV1235-004LF		
				Marking: DR3		
	SMV1235-011LF					
	Marking: DR					
SMV1236-079	SMV1236-011	SMV1236-001		SMV1236-004		SMV1236-074
Marking: Cathode	Marking: AQ	Marking: AQ1		Marking: AQ3		Marking: AQ3
SMV1236-079LF	SMV1236-011LF			SMV1236-004LF		
Marking: Cathode	Marking: DQ			Marking: EQ3		
		SMV1237-001		SMV1237-004		SMV1237-074
		Marking: VT1		Marking: VT3		Marking: VT3
$L_S = 0.7 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.5 \text{ nH}$	$L_S = 1.4 \text{ nH}$	$L_S = 1.4 \text{ nH}$

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

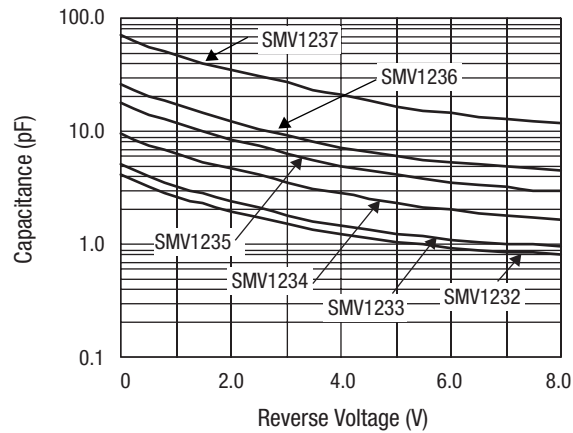
Electrical Specifications at 25 °C

Part Number	$C_T @ 1 \text{ V}$ (pF)		$C_T @ 3 \text{ V}$ (pF)	$C_T @ 6 \text{ V}$ (pF)	$\frac{C_T @ 1 \text{ V}}{C_T @ 3 \text{ V}}$ (Ratio)		$\frac{C_T @ 1 \text{ V}}{C_T @ 6 \text{ V}}$ (Ratio)		$R_S @ 3 \text{ V}$ 500 MHz (Ω)	$Q @ 3 \text{ V}$ 50 MHz
	Min.	Max.	Typ.	Typ.	Min.	Max.	Min.	Max.	Max.	Typ.
SMV1232	2.34	2.86	1.5	0.94	1.5	1.9	2.6	3.3	1.50	1400
SMV1233	3.00	3.60	1.8	1.10	1.5	1.9	2.6	3.3	1.20	1200
SMV1234	5.85	7.15	3.6	2.00	1.6	2.0	2.8	3.4	0.80	1000
SMV1235	10.35	12.65	6.4	3.60	1.6	2.0	2.9	3.4	0.60	750
SMV1236	15.50	18.50	9.2	5.30	1.6	2.0	3.0	3.5	0.50	700
SMV1237	45.00	54.00	26.9	14.40	1.6	2.0	3.0	3.5	0.25	500

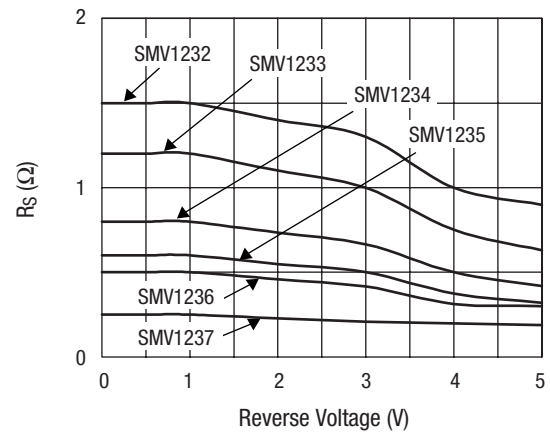
Reverse Voltage V_R ($I_R = 10 \mu\text{A}$): 15 V minimum.

Reverse Current I_R ($V_R = 12 \text{ V}$): 20 nA maximum.

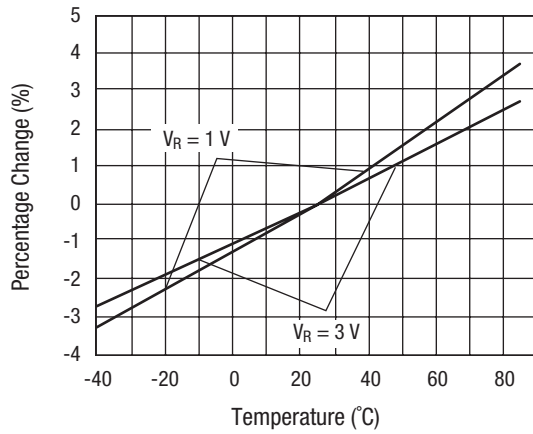
Typical Performance Data



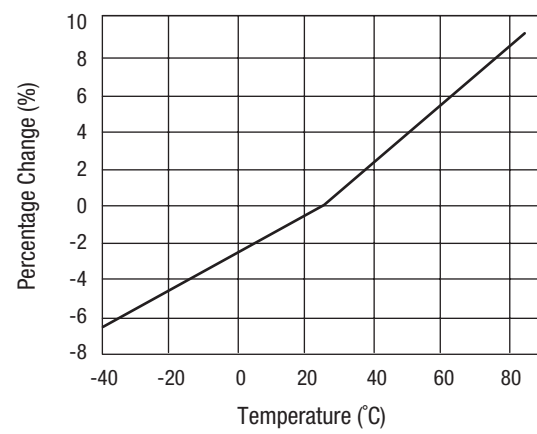
Capacitance vs. Reverse Voltage



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



**Relative Capacitance Change
vs. Temperature**

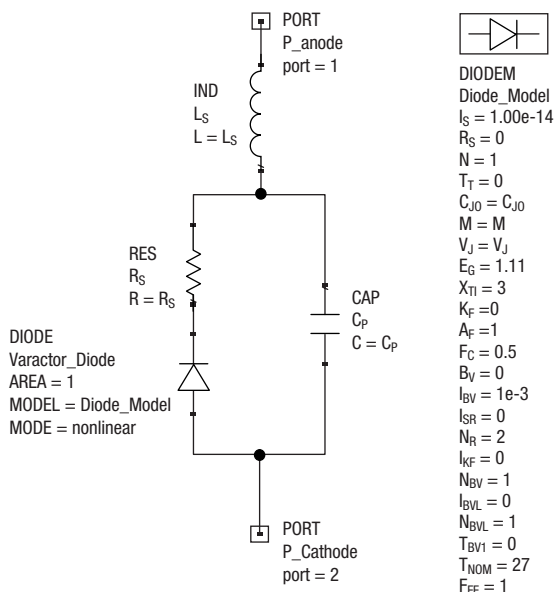


**Relative Series Resistance Change
vs. Temperature @ 500 MHz**

Typical Capacitance Values

V_R (V)	SMV1232	SMV1233	SMV1234	SMV1235	SMV1236	SMV1237
	C_T (pF)	C_T (pF)	C_T (pF)	C_T (pF)	C_T (pF)	C_T (pF)
0.0	4.15	5.08	9.63	18.22	26.75	71.82
0.5	3.22	3.95	7.53	14.12	20.61	56.10
1.0	2.67	3.28	6.28	11.67	17.02	46.89
1.5	2.28	2.80	5.39	9.91	14.38	40.33
2.0	1.97	2.41	4.68	8.52	12.29	35.13
2.5	1.72	2.09	4.09	7.36	10.56	30.71
3.0	1.51	1.82	3.58	6.40	9.16	26.87
3.5	1.35	1.62	3.15	5.62	8.04	23.57
4.0	1.22	1.45	2.81	4.99	7.19	20.83
4.5	1.13	1.33	2.54	4.50	6.53	18.62
5.0	1.05	1.24	2.32	4.11	6.01	16.87
5.5	0.99	1.16	2.15	3.80	5.61	15.48
6.0	0.94	1.10	2.02	3.55	5.28	14.36
6.5	0.90	1.05	1.90	3.34	5.02	13.46
7.0	0.86	1.01	1.80	3.17	4.81	12.72
7.5	0.84	0.98	1.72	3.03	4.64	12.11
8.0	0.81	0.96	1.65	2.91	4.49	11.61
9.0	0.78	0.92	1.55	2.73	4.28	10.87
10.0	0.76	0.90	1.47	2.61	4.13	10.38
11.0	0.75	0.88	1.42	2.53	4.02	10.06
12.0	0.74	0.87	1.38	2.47	3.95	9.84
13.0	0.73	0.86	1.35	2.43	3.89	9.68
14.0	0.73	0.85	1.33	2.40	3.84	9.56
15.0	0.72	0.84	1.32	2.38	3.80	9.47

SPICE Model



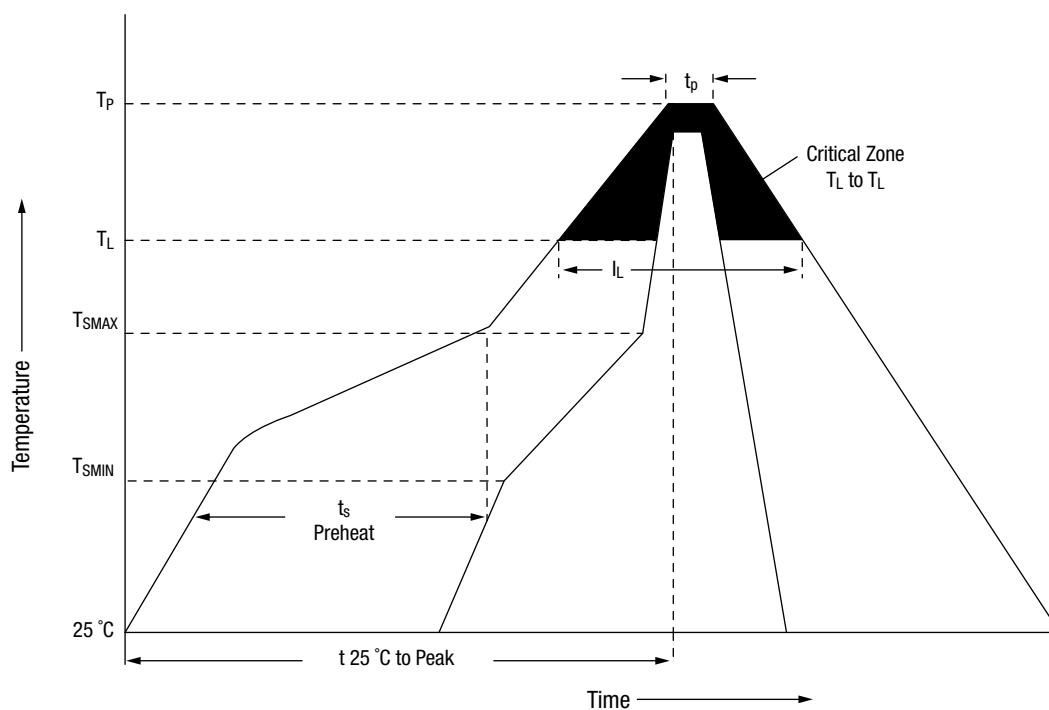
Part Number	C_{JO} (pF)	V_J (V)	M	C_P (pF)	R_S (Ω)
SMV1232	4.20	1.7	0.9	0.0	1.50
SMV1233	4.12	1.7	0.9	0.7	1.20
SMV1234	8.75	2.3	1.1	1.2	0.80
SMV1235	16.13	8.0	4.0	2.0	0.60
SMV1236	21.63	8.0	4.2	3.2	0.50
SMV1237	66.16	10.0	5.3	9.0	0.25

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.

Recommended Solder Reflow Profiles

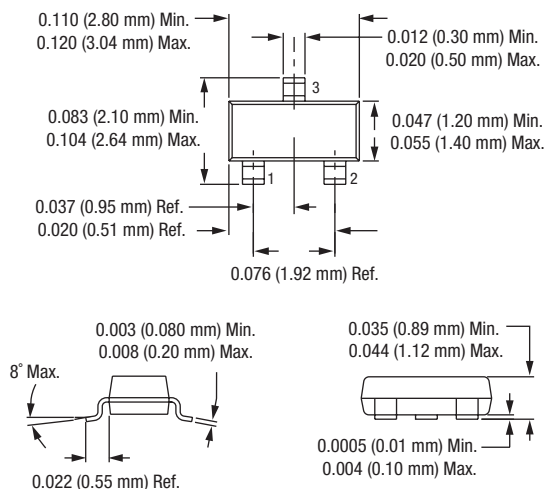
Profile Feature	SnPb Eutectic Assembly	Lead (Pb)-Free Assembly 100% Sn
Average ramp-up rate (T_L to T_P)	3 °C/second max.	3 °C/second max.
Preheat		
Temperature min. (T_{SMIN})	100 °C	150 °C
Temperature max. (T_{SMAX})	150 °C	200 °C
Time (min. to max.) (t_s)	60–120 seconds	60–80 seconds
T_{SMAX} to T_L Ramp-up rate	—	3 °C/second max.
Time maintained above: Temperature (T_L)	183 °C	217 °C
Time (t_L)	60–150 seconds	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.

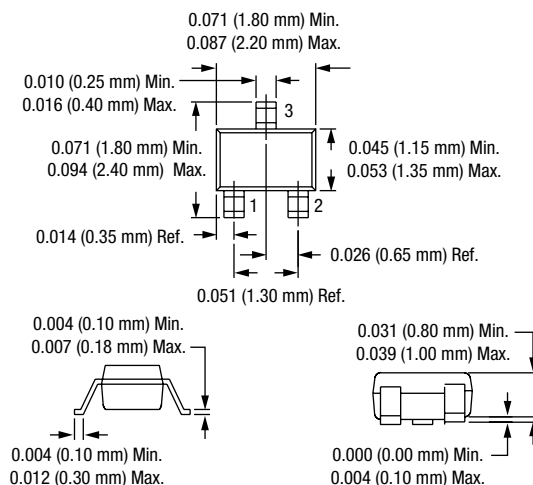


Reference JEDEC J-STD-020

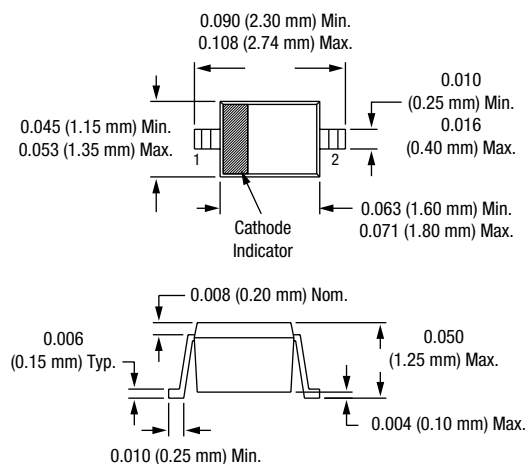
SOT-23



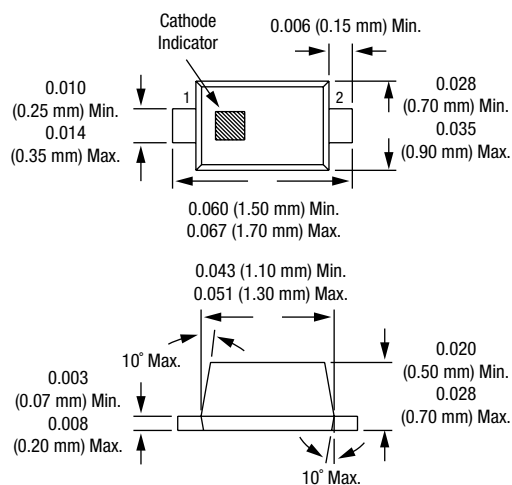
SC-70



SOD-323



SC-79



Copyright © 2002, 2003, 2004, Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products. These materials are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials. Skyworks may make changes to its documentation, products, specifications and product descriptions at any time, without notice. Skyworks makes no commitment to update the information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from future changes to its documentation, products, specifications and product descriptions.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by or under this document. Except as may be provided in Skyworks Terms and Conditions of Sale for such products, Skyworks assumes no liability whatsoever in association with its documentation, products, specifications and product descriptions.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED OR OTHERWISE, RELATING TO SALE AND/OR USE OF SKYWORKS PRODUCTS INCLUDING WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. SKYWORKS FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THESE MATERIALS WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

The following are trademarks of Skyworks Solutions, Inc.: Skyworks™, the Skyworks logo, and Breakthrough Simplicity™. Product names or services listed in this publication are for identification purposes only, and may be trademarks of Skyworks or other third parties. Third-party brands and names are the property of their respective owners. Additional information, posted at www.skyworksinc.com, is incorporated by reference.