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SKYWORKS®

DATA SHEET

SMV1231–SMV1237: Hyperabrupt Tuning Varactors

Features

- High capacitance ratio
- 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 SMV1231–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 SMV1231–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
SMV1231-079 Marking: Cathode	**SMV1231-011** Marking: JA			**SMV1231-004** Marking: JA3		**SMV1231-074** Marking: JA3
						SMV1231-074LF Marking: KA3
SMV1232-079 Marking: Cathode	**SMV1232-011** Marking: CC			**SMV1232-004**		**SMV1232-074** Marking: CC3
						SMV1232-074LF Marking: DP3
SMV1233-079 Marking: Cathode	**SMV1233-011** Marking: VP	**SMV1233-001** Marking: VP1	**SMV1233-003** Marking: VP9	**SMV1233-004** Marking: VP3	**SMV1233-073** Marking: VP9	**SMV1233-074** Marking: VP3
	SMV1233-011LF Marking: DP					
SMV1234-079 Marking: Cathode	**SMV1234-011** Marking: VQ	**SMV1234-001** Marking: VQ1	**SMV1234-003** Marking: VQ9	**SMV1234-004** Marking: VQ3	**SMV1234-073** Marking: VQ9	**SMV1234-074** Marking: VQ3
SMV1234-079LF Marking: Cathode	**SMV1234-011LF** Marking: DQ					
SMV1235-079 Marking: Cathode	**SMV1235-011** Marking: VR	**SMV1235-001** Marking: VR1		**SMV1235-004** Marking: VR3		**SMV1235-074** Marking: VR3
				SMV1235-004LF Marking: DR3		
	SMV1235-011LF Marking: DR					
SMV1236-079 Marking: Cathode	**SMV1236-011** Marking: AQ	**SMV1236-001** Marking: AQ1		**SMV1236-004** Marking: AQ3		**SMV1236-074** Marking: AQ3
SMV1236-079LF Marking: Cathode	**SMV1236-011LF** Marking: DQ			**SMV1236-004LF** Marking: EQ3		
		SMV1237-001 Marking: VT1		**SMV1237-004** Marking: VT3		**SMV1237-074** Marking: VT3
L_S = 0.7 nH	L_S = 1.5 nH	L_S = 1.5 nH	L_S = 1.5 nH	L_S = 1.5 nH	L_S = 1.4 nH	L_S = 1.4 nH

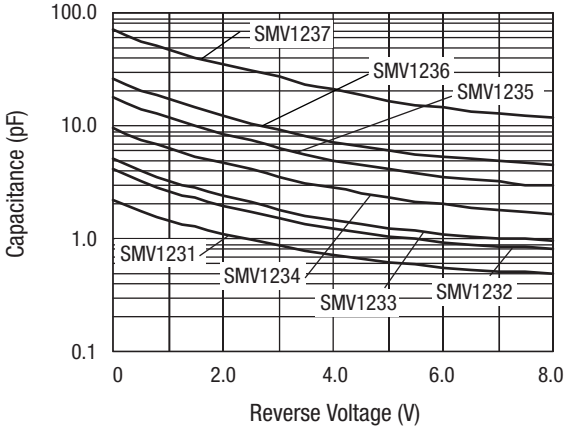
LF denotes lead (Pb)-free packaging option as an alternative to our standard tin/lead (Sn/Pb) packaging.

Electrical Specifications at 25 °C

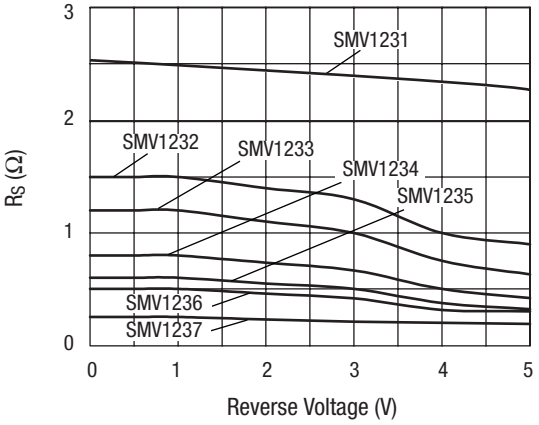
Part Number	C_T @ 1 V (pF)		C_T @ 3 V (pF)	C_T @ 6 V (pF)	$\frac{C_T \text{ @ 1 V}}{C_T \text{ @ 3 V}}$ (Ratio)		$\frac{C_T \text{ @ 1 V}}{C_T \text{ @ 6 V}}$ (Ratio)		R_S @ 3 V 500 MHz (Ω)	Q @ 3 V 50 MHz
	Min.	Max.	Typ.	Typ.	Min.	Max.	Min.	Max.	Max.	Typ.
SMV1231	1.43	1.72	0.97	0.61	1.5	1.8	2.5	2.8	2.90	1500
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

Tested in -079 package.
Reverse Voltage V_R (I_R = 10 μA): 15 V minimum.
Reverse Current I_R (V_R = 12 V): 20 nA maximum.

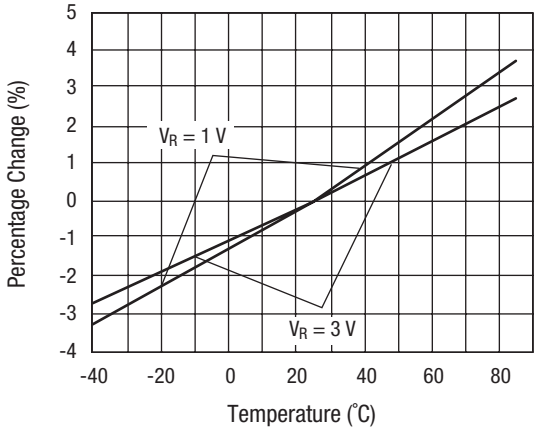
Typical Performance Data



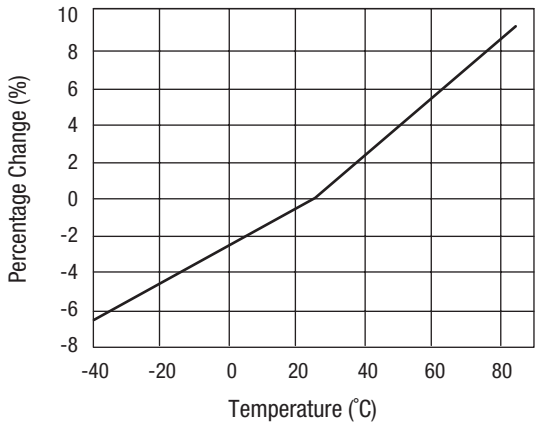
Capacitance vs. Reverse Voltage



Series Resistance vs. Reverse Voltage @ 500 MHz



Relative Capacitance Change vs. Temperature

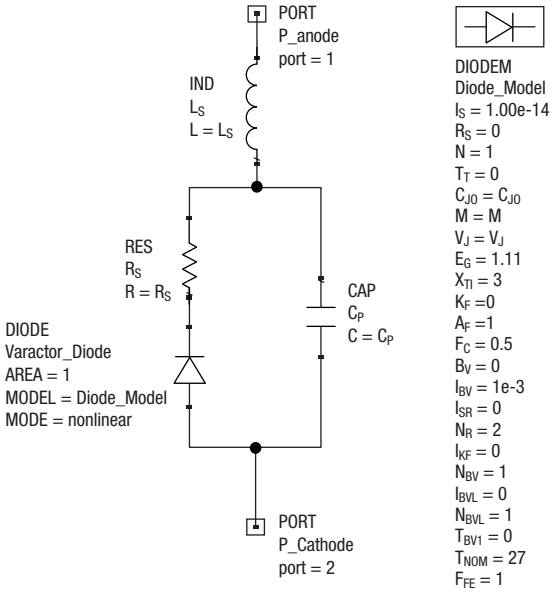


Relative Series Resistance Change vs. Temperature @ 500 MHz

Typical Capacitance Values

	SMV1231	SMV1232	SMV1233	SMV1234	SMV1235	SMV1236	SMV1237
V_R (V)	C_T (pF)	C_T (pF)	C_T (pF)	C_T (pF)	C_T (pF)	C_T (pF)	C_T (pF)
0.0	2.350	4.15	5.08	9.63	18.22	26.75	71.82
0.5	1.870	3.22	3.95	7.53	14.12	20.61	56.10
1.0	1.580	2.67	3.28	6.28	11.67	17.02	46.89
1.5	1.400	2.28	2.80	5.39	9.91	14.38	40.33
2.0	1.220	1.97	2.41	4.68	8.52	12.29	35.13
2.5	1.090	1.72	2.09	4.09	7.36	10.56	30.71
3.0	0.970	1.51	1.82	3.58	6.40	9.16	26.87
3.5	0.882	1.35	1.62	3.15	5.62	8.04	23.57
4.0	0.794	1.22	1.45	2.81	4.99	7.19	20.83
4.5	0.732	1.13	1.33	2.54	4.50	6.53	18.62
5.0	0.683	1.05	1.24	2.32	4.11	6.01	16.87
5.5	0.648	0.99	1.16	2.15	3.80	5.61	15.48
6.0	0.613	0.94	1.10	2.02	3.55	5.28	14.36
6.5	0.590	0.90	1.05	1.90	3.34	5.02	13.46
7.0	0.567	0.86	1.01	1.80	3.17	4.81	12.72
7.5	0.551	0.84	0.98	1.72	3.03	4.64	12.11
8.0	0.534	0.81	0.96	1.65	2.91	4.49	11.61
9.0	0.512	0.78	0.92	1.55	2.73	4.28	10.87
10.0	0.497	0.76	0.90	1.47	2.61	4.13	10.38
11.0	0.492	0.75	0.88	1.42	2.53	4.02	10.06
12.0	0.487	0.74	0.87	1.38	2.47	3.95	9.84
13.0	0.480	0.73	0.86	1.35	2.43	3.89	9.68
14.0	0.472	0.73	0.85	1.33	2.40	3.84	9.56
15.0	0.466	0.72	0.84	1.32	2.38	3.80	9.47

SPICE Model



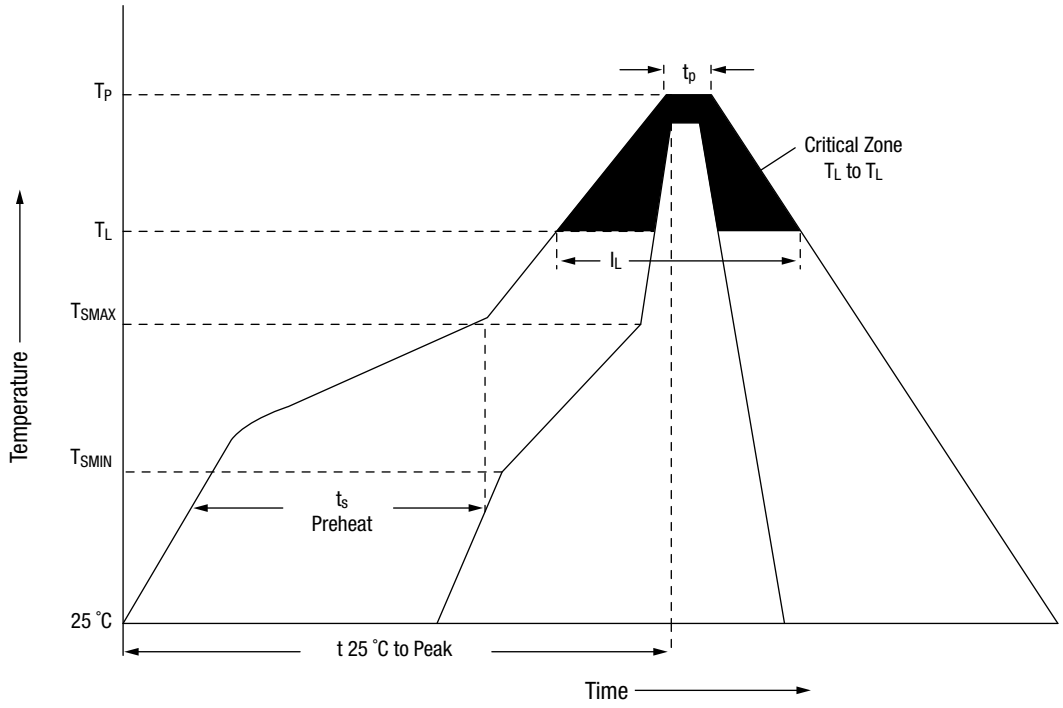
Part Number	C_{J0} (pF)	V_J (V)	M	C_P (pF)	R_S (Ω)
SMV1231	–	1.5	0.8	0.0	2.50
SMV1232	4.20	1.7	0.9	0.0	1.50
SMV1233	4.12	1.7	0.9	0.7	1.20
SMV1234	8.75	2.3	1.1	1.2	0.80
SMV1235	16.13	8.0	4.0	2.0	0.60
SMV1236	21.63	8.0	4.2	3.2	0.50
SMV1237	66.16	10.0	5.3	9.0	0.25

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

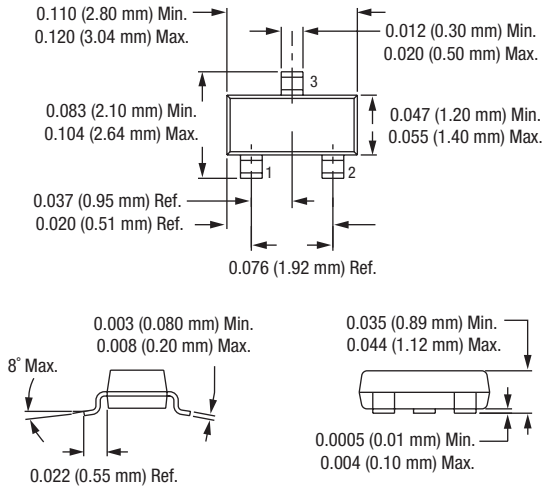
Profile Feature	SnPb Eutectic Assembly	Lead (Pb)-Free Assembly 100% Sn
Average ramp-up rate (T_L to T_P)	3 °C/second max.	3 °C/second max.
Preheat Temperature min. (T_{SMIN}) Temperature max. (T_{SMAX}) Time (min. to max.) (ts)	 100 °C 150 °C 60–120 seconds	 150 °C 200 °C 60–80 seconds
T_{SMAX} to T_L 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 (tp)	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 topside of the package, measured on the package body surface.
Reference JEDEC J-STD-020C.

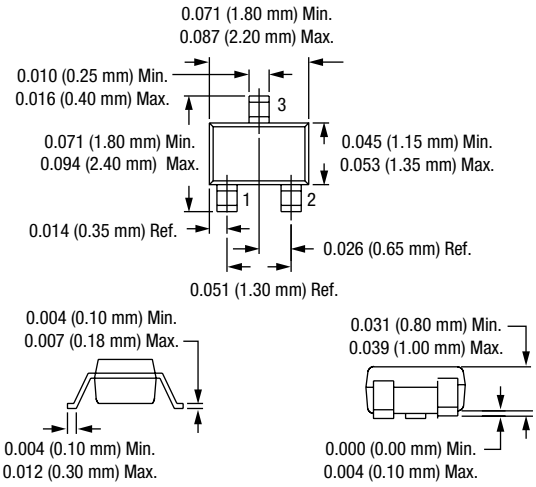


Reference JEDEC J-STD-020

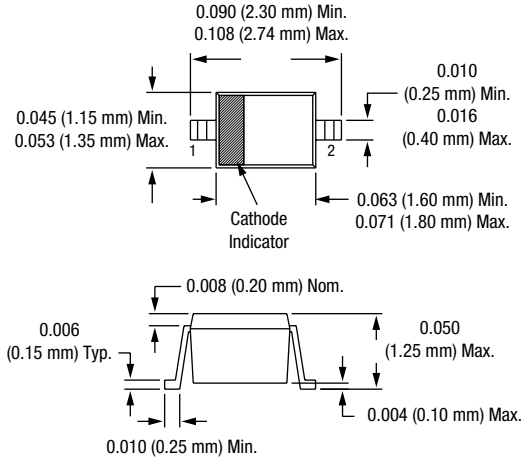
SOT-23



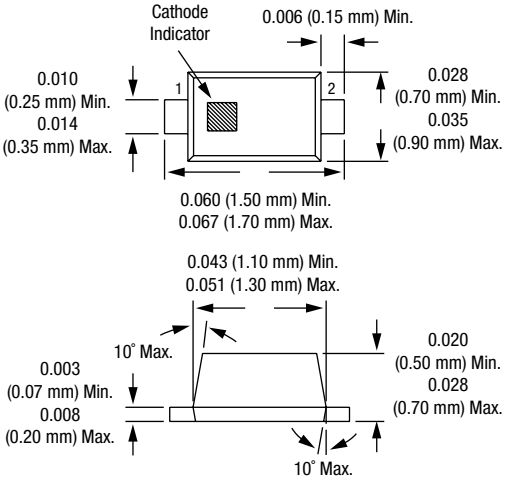
SC-70



SOD-323



SC-79



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