

DATA SHEET

# SMV1405-SMV1413 Series: Plastic Packaged Abrupt Junction Tuning Varactors

## Applications

- High-Q resonators in wireless system VCOs
- High volume commercial systems

## Features

- High Q
- Low series resistance for low phase noise
- Packages rated MSL1, 260 °C per JEDEC J-STD-020







Skyworks offers lead (Pb)-free, RoHS (Restriction of Hazardous Substances) compliant packaging.

## Description

The SMV1405-SMV1413 group of silicon abrupt junction varactor diodes is designed for use in Voltage Controlled Oscillators (VCOs) requiring tight capacitance tolerances. The low resistance of these varactors makes them appropriate for high-Q resonators in wireless system VCOs to frequencies above 2.5 GHz. This family of varactors is characterized for capacitance over temperature.

Table 1 describes the various packages and markings of the SMV1405-SMV1413 group of varactors.

**Table 1. Packaging and Marking**

			
Single	Single	Common Cathode	Common Cathode
SC-79	SOT-23	SOT-23	SC-70
<b>SMV1405-079LF</b> Marking: Cathode			<b>SMV1405-074</b> Marking: BE3
	<b>SMV1408-001</b> Marking: VV1		<b>SMV1405-074LF</b> Marking: GE3
	<b>SMV1408-001LF</b> Marking: DV1		
	<b>SMV1413-001</b> Marking: AR1	<b>SMV1413-004</b> Marking: AR3	
<b>SMV1413-079LF</b> Marking: Cathode	<b>SMV1413-001LF</b> Marking: ER1	<b>SMV1413-004LF</b> Marking: ER3	<b>SMV1413-074LF</b> Marking: ER3
Ls = 0.7 nH	Ls = 1.5 nH	Ls = 1.5 nH	Ls = 1.4 nH



LF denotes lead (Pb)-free, RoHS-compliant packaging option as an alternative to the standard Skyworks tin/lead (Sn/Pb) packaging.

**Table 2. SMV1405-SMV1413 Series Absolute Maximum Ratings**

Parameter	Symbol	Minimum	Typical	Maximum	Units
Reverse voltage	$V_R$			30	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

**Note:** 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.

**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 should be used at all times. The SMV1405-SMV1413 group of varactors are Class 0 Human Body Model (HBM) ESD devices.

**Table 3. SMV1405-SMV1413 Series Electrical Specifications (Note 1)**  
( $T_{OP} = 25\text{ °C}$ , Unless Otherwise Noted)

Part Number	$C_T @ 0.5\text{ V}$ (pF)	$C_T @ 1\text{ V}$ (pF)	$C_T @ 4\text{ V}$ (pF)		$\frac{C_T @ 0\text{ V}}{C_T @ 30\text{ V}}$ (Ratio)	$R_S @ 4\text{ V},$ 500 MHz ( $\Omega$ )	$Q @ 4\text{ V},$ 50 MHz
	Typ.	Typ.	Min.	Max.	Min	Max.	Typ.
SMV1405	2.1	1.8	1.21	1.45	4.1	0.8	3200
SMV1408	3.4	2.9	1.75	2.11	4.1	0.6	2900
SMV1413	7.4	6.4	3.64	4.42	4.2	0.35	2400

**Note 1:** Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

Reverse voltage  $V_R$  ( $I_R = 10\ \mu\text{A}$ ) = 30 V minimum  
Reverse current  $I_R$  ( $V_R = 24\text{ V}$ ) = 20 nA maximum

### Electrical and Mechanical Specifications

The absolute maximum ratings of the SMV1405-SMV1413 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 SMV1405-SMV1413 varactors are illustrated in Figures 1 and 2.

The SPICE model for the SMV1405-SMV1413 varactors is shown in Figure 3 and the associated model parameters are provided in Table 5.

Package dimensions are shown in Figures 4 to 8 (even numbers), and tape and reel dimensions are provided in Figures 5 to 9 (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.

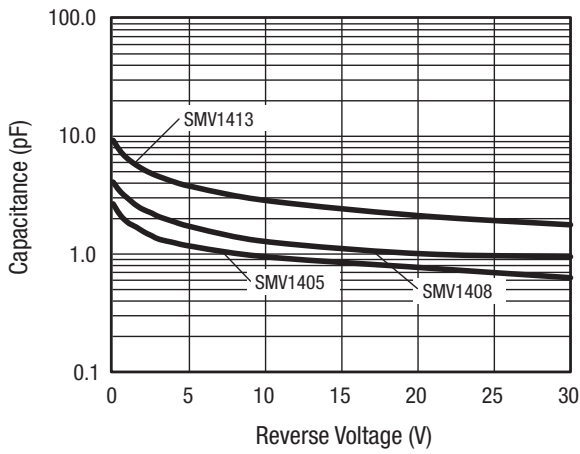
The SMV1405-SMV1413 series of varactors are rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. They can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164

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. For packaging details, refer to the Skyworks Application Note *Discrete Devices and IC Switch/Attenuators Tape and Reel Package Orientation*, document number 200083.

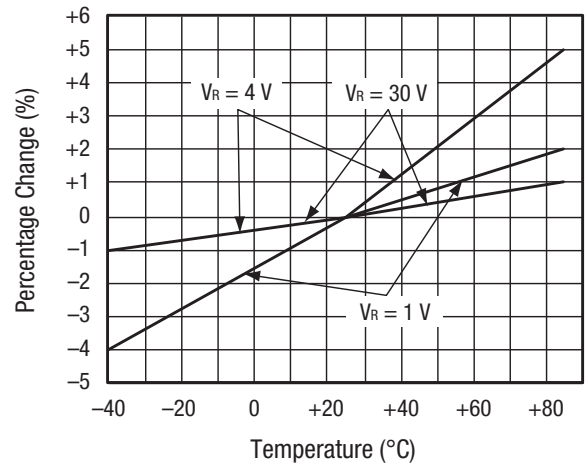
**Table 4. Capacitance vs Reverse Voltage**

V <sub>R</sub> (V)	C <sub>T</sub> (pF)		
	SMV1405	SMV1408	SMV1413
0	2.67	4.08	9.24
0.5	2.12	3.36	7.39
1.0	1.84	2.94	6.37
1.5	1.70	2.60	5.71
2.0	1.55	2.38	5.22
2.5	1.44	2.24	4.85
3.0	1.34	2.08	4.55
4.0	1.25	1.88	4.10
5.0	1.17	1.72	3.77
10.0	0.95	1.28	2.85
20.0	0.77	1.01	2.12
30.0	0.63	0.95	1.77

**Typical Performance Characteristics**



**Figure 1. Capacitance vs Reverse Voltage**



**Figure 2. Relative Capacitance Change vs Temperature**



Figure 3. SPICE Model

Table 5. SPICE Model Parameters

Part Number	C <sub>J0</sub> (pF)	V <sub>J</sub> (V)	M	C <sub>P</sub> (pF)	R <sub>S</sub> (Ω)
SMV1405	2.92	0.68	0.41	0.05	0.80
SMV1408	3.70	0.80	0.48	0.13	0.60
SMV1413	9.20	0.79	0.45	0.13	0.35

Values extracted from measured performance.

For package inductance (L<sub>s</sub>, refer to Table 1.

For more details, refer to the Skyworks Application Note, *Varactor SPICE Model for Approved RF VCO Applications*, document number 200315.

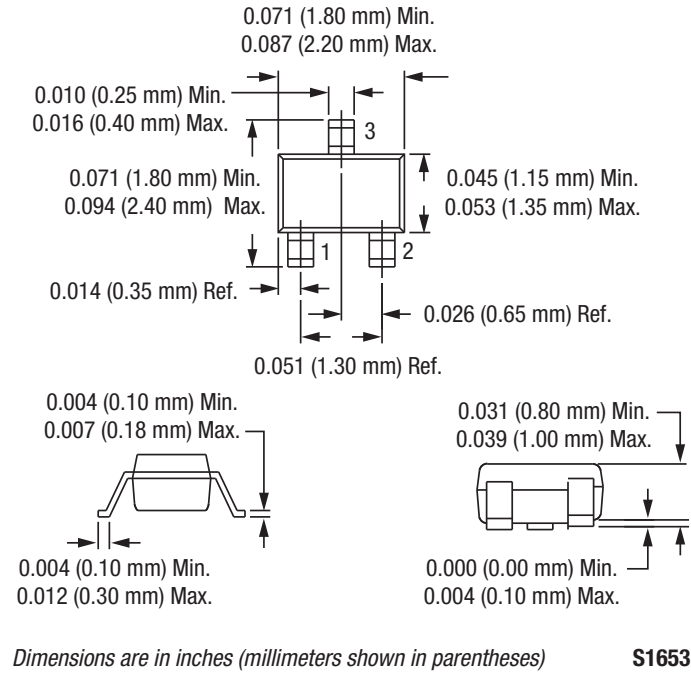


Figure 4. SC-70 Package Dimensions

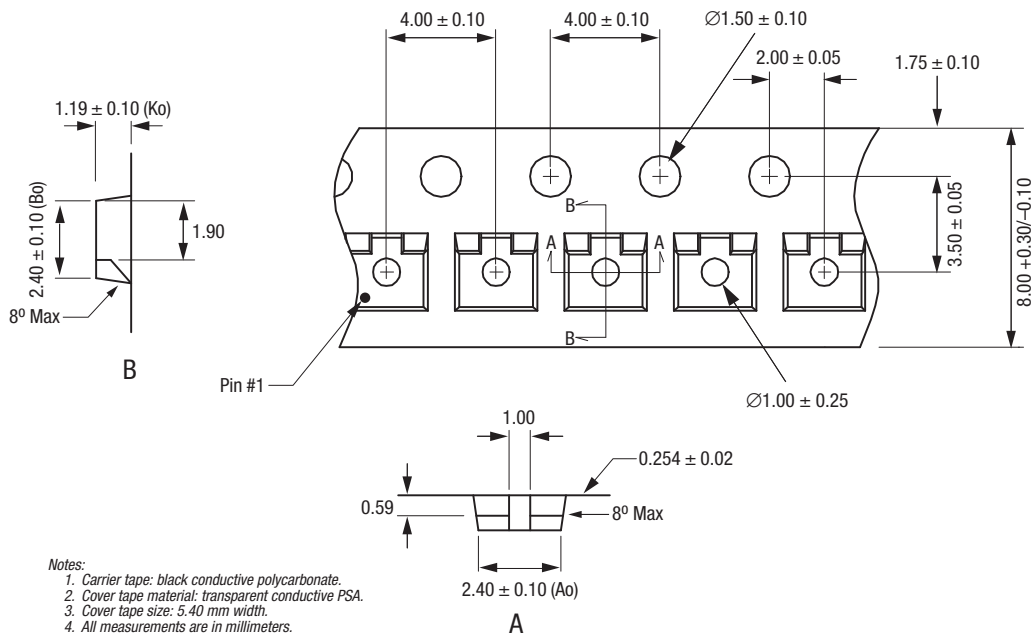
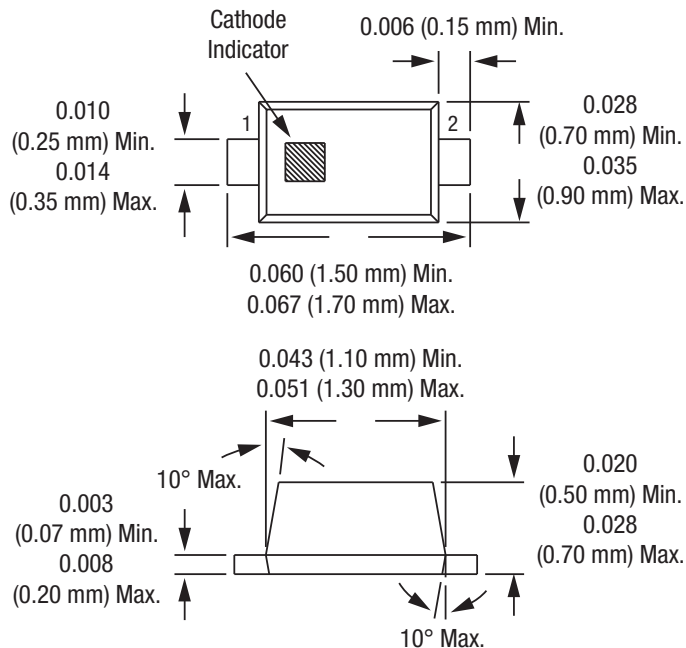
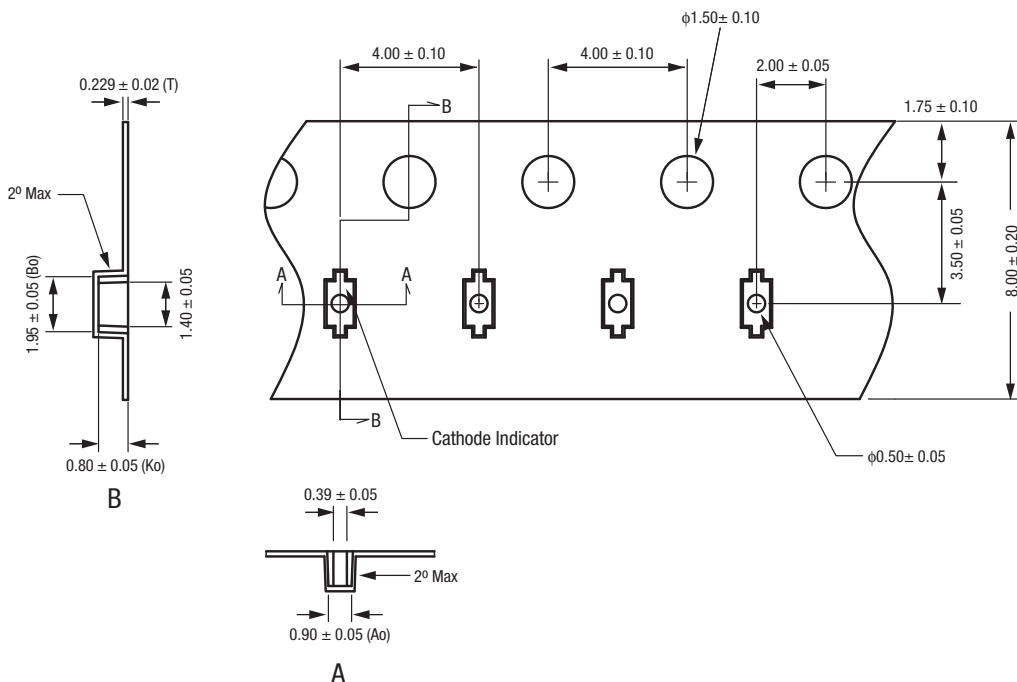


Figure 5. SC-70 Tape and Reel Dimensions



Dimensions are in inches (millimeters shown in parentheses) S1652

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. All measurements are in millimeters.

S1673

Figure 7. SC-79 Tape and Reel Dimensions



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