PRELIMINARY DATA SHEET

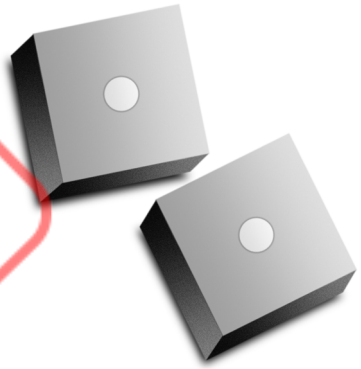
# SMV2025 Hyperabrupt Tuning Varactors Supplied on Film Frame and Waffle Packs

## Applications

- Wide-bandwidth and low phase-noise VCOs
- Wide-range, voltage-tuned phase shifters and filters
- Miniature RF and microwave tuners

## Features

- Low series resistance and leakage current for low phase-noise VCOs
- High-capacitance ratio: $C_T$ (2 V)/$C_T$ (10 V) = 2.2 minimum
- Broad 18 V tuning range
- Competitive cross to Toshiba 1SV280 varactor diode in die form
- Available as:
  - Full wafer on film frame (SMV2025-099)
  - Dice in waffle packs (SMV2025-000)
- Small footprint chip size: 10.5 x 10.5 x 5.5 mils
- For RoHS and other product compliance information, see the Skyworks Certificate of Conformance.





## Description

The SMV2025 series are silicon surface mount, hyperabrupt tuning varactor diodes, excellent for use as high-Q tuning elements in an RF Voltage Controlled Oscillator (VCO), voltage-controlled phase shifter, or tunable bandpass filter.

The minimum capacitance ratio from 2 V to 10 V is 2.2, which makes the SMV2025 series suitable for wide-bandwidth VCOs and wide phase-range phase shifters.

The SMV2025-099 is supplied as 100-percent electrically tested, fully singulated wafers mounted on a film frame. The SMV2025-000 is supplied as a 100-percent electrically tested die in waffle packs.

The absolute maximum ratings of the SMV2025 varactors are provided in Table 1. Electrical specifications are provided in Table 2. Typical performance characteristics are shown in Figure 1 and Figure 2. Typical capacitance values for reverse voltages between 0 and 20 V are summarized in Table 3. The SPICE model for the SMV2025 die is shown in Figure 3, and the associated model parameters are provided in Table 4. Die mechanical characteristics are listed in Table 5.

**Table 1. SMV2025-000/-099 Absolute Maximum Ratings**

| Parameter | Symbol | Minimum | Maximum | Units |
|---|---|---|---|---|
| Power dissipation at cathode temperature of 25 °C | $P_{DIS}$ | | 250 | mW |
| Reverse voltage | $V_R$ | | 20 | V |
| Forward current | $I_F$ | | 100 | mA |
| Junction temperature | $T_J$ | –55 | +150 | °C |
| Storage temperature | $T_{STG}$ | –55 | +150 | °C |
| Electrostatic Discharge:<br>Charged Device Model (CDM), Class 4<br>Human Body Model (HBM), Class 3A<br>Machine Model (MM), Class C | ESD | | <br>1000<br>4000<br>400 | <br>V<br>V<br>V |

**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.*



**Table 2. SMV2025-000/-099 Electrical Specifications (Note 1) (Note 2)**
**(Cathode Temperature = 25 °C, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Reverse breakdown voltage | $V_{BR}$ | $I_R$ = 10 µA | 20 | | | V |
| Reverse leakage current | $I_R$ | $V_R$ = 19 V | | | 20 | nA |
| Junction capacitance | $C_{J2}$ | $V_R$ = 2 V, f = 1 MHz | 4.12 | | 5.03 | pF |
| | $C_{J10}$ | $V_R$ = 10 V, f = 1 MHz | 1.52 | | 1.93 | pF |
| | $C_{J18}$ | $V_R$ = 18 V, f = 1 MHz | 0.98 | | 1.18 | pF |
| Capacitance ratio | $C_{J2}/C_{J10}$ | | 2.27 | 2.6 | | – |
| Series resistance | $R_S$ | $V_R$ = 1 V, f = 470 MHz | | 0.5 | 0.8 | Ω |

**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.

**Note 2:** The SMV2025-000 and SMV2025-099 are 100% tested for junction capacitance, capacitance ratio. reverse leakage current, and breakdown voltage. Electrical rejects of the SMV2025-099 devices (singulated wafer on film frame) are identified with black ink.

## Typical Performance Characteristics

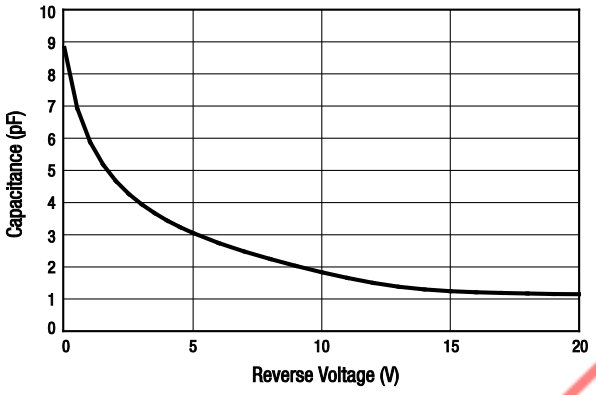



**Figure 1. Capacitance vs Reverse Voltage**

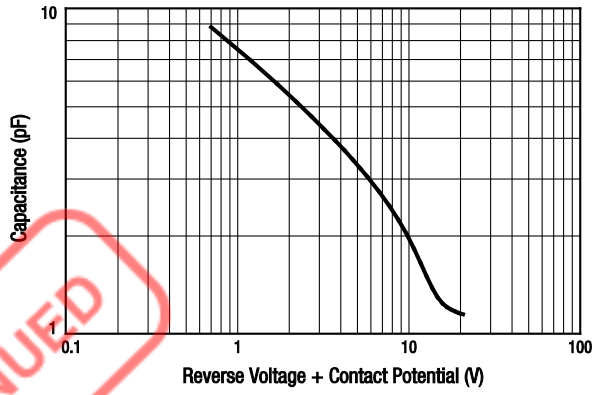



**Figure 2. Capacitance vs Reverse Voltage (Logarithmic Plot)**



**Table 3. Reverse Voltage vs Typical Capacitance**

| $V_R$ (V) | $C_T$ (pF) | $V_R$ (V) | $C_T$ (pF) |
|---|---|---|---|
| 0 | 8.81 | 8.0 | 2.24 |
| 0.5 | 6.93 | 9.0 | 2.03 |
| 1.0 | 5.88 | 10.0 | 1.83 |
| 1.5 | 5.18 | 11.0 | 1.65 |
| 2.0 | 4.67 | 12.0 | 1.50 |
| 2.5 | 4.27 | 13.0 | 1.38 |
| 3.0 | 3.94 | 14.0 | 1.30 |
| 3.5 | 3.67 | 15.0 | 1.24 |
| 4.0 | 3.44 | 16.0 | 1.21 |
| 4.5 | 3.23 | 17.0 | 1.19 |
| 5.0 | 3.05 | 18.0 | 1.17 |
| 6.0 | 2.74 | 19.0 | 1.16 |
| 7.0 | 2.47 | 20.0 | 1.15 |

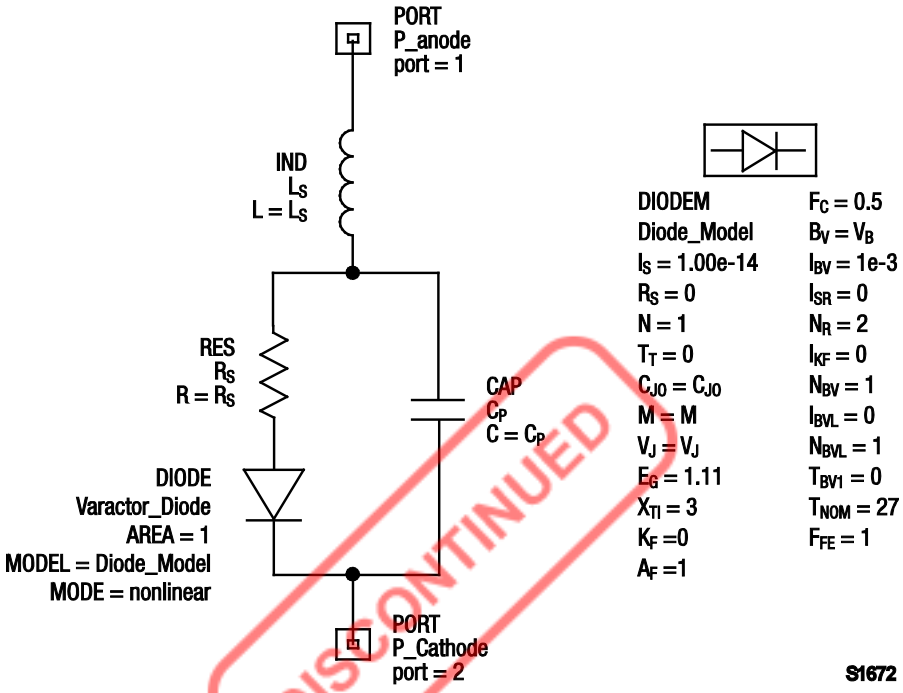





**Figure 3. SPICE Model**

**Table 4. SPICE Model Parameters**

| Part Number | $C_{J0}$ (pF) | $V_J$ (V) | M | $C_P$ (pF) | $R_S$ (Ω) | $L_S$ (nH) |
|---|---|---|---|---|---|---|
| SMV2025-000 | 8.8 | 1.05 | 0.7 | 0.07 | 0.8 | 0.15 |
| SMV2025-099 | 8.8 | 1.05 | 0.7 | 0.07 | 0.8 | 0.15 |

**Table 5. SMV2025 Die Characteristics**

| Part Number | Quantity of Good Dice Per Wafer | Chip Size | | Chip Thickness | | Typical Anode Contact Diameter | |
|---|---|---|---|---|---|---|---|
| | | (in) | (mm) | (in) | (mm) | (in) | (mm) |
| SMV2025-000 | N/A | 0.0105 x 0.0105 ± 0.002 | 0.2667 x 0.2667 ± 0.050 | 0.005 ± 0.001 | 0.127 ± 0.0254 | 0.0035 | 0.0889 |
| SMV2025-099 | 55,000 minimum 60,000 nominal | 0.0105 x 0.0105 ± 0.002 | 0.2667 x 0.2667 ± 0.050 | 0.005 ± 0.001 | 0.127 ± 0.0254 | 0.0035 | 0.0889 |



## Package Outline Drawings

Table 5 identifies the die part numbers with their corresponding quantity per wafer and chip measurements. The package outline die drawing for the SMV2025-000 (dice in waffle packs) is shown in Figure 4. The package outline die drawing for the SMV2025-099 (full wafer on film frame) is shown in Figure 5.

The SMV2025-000 is supplied in quantities of 100 pieces per waffle pack.

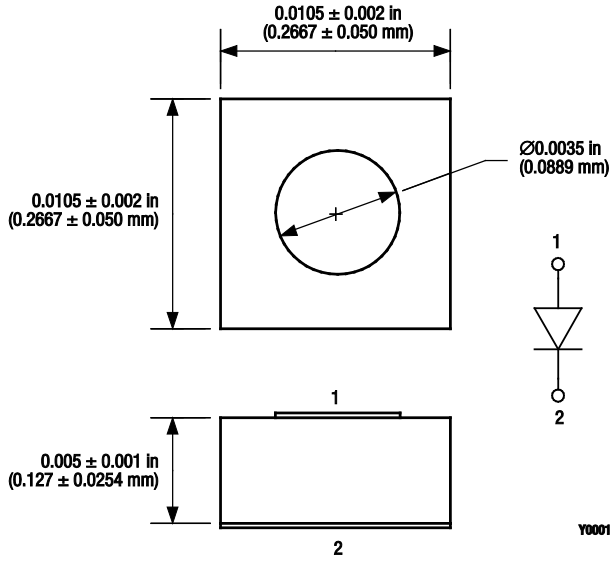



**Figure 4. SMV2025-000 Die Outline Drawing (Dice in Waffle Packs)**

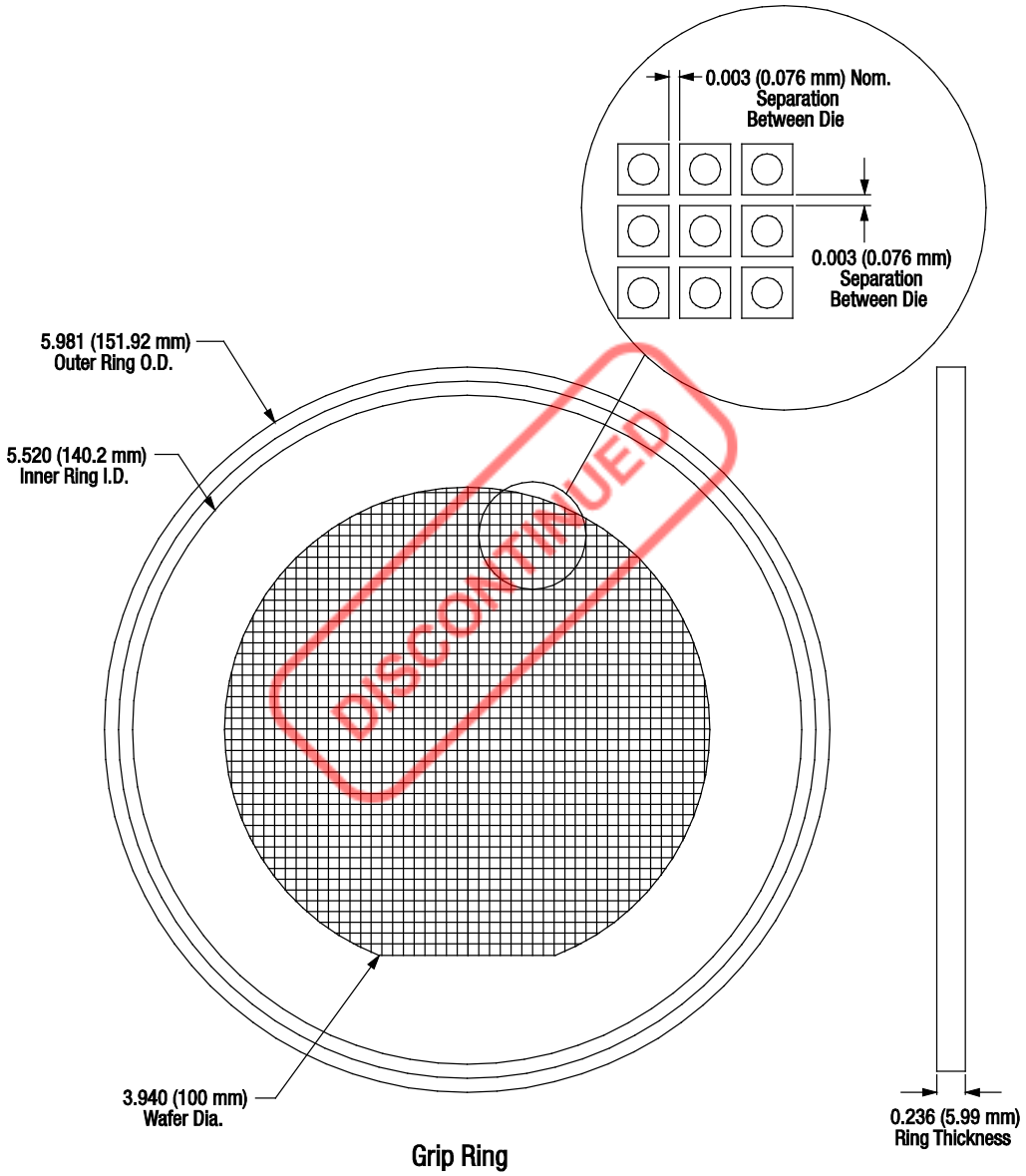



**Figure 5. SMV2025-099 Die Outline Drawing**
**(Full Wafer on Film Frame)**

## Ordering Information

| Model Name | Manufacturing Part Number |
|---|---|
| SMV2025-000 (dice, 100 per waffle pack) | SMV2025-000 |
| SMV2025-099 (singulated wafer on film frame) | SMV2025-099 |