

DATA SHEET

# SMV2019 to SMV2023: Silicon Hyperabrupt Junction Varactors, Packaged and Bondable Planar Chips

## Applications

- Voltage controlled oscillators

## Features

- High Q for low loss resonators
- Low leakage current
- High tuning ratio for wideband VCOs
- SPICE model parameters
- Small footprint chip design
- Lead (Pb)-free, RoHS-compliant, and Green™

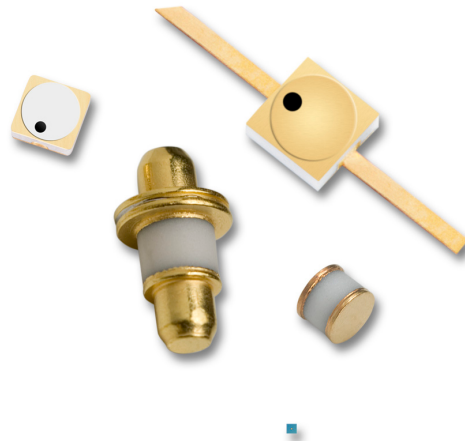
## Description

Skyworks silicon hyperabrupt junction varactor diodes are processed using established ion-implantation technology resulting in low  $R_S$  wide tuning ratio devices with high Q values. These diodes are available as chips or in ceramic packages. These planar chips have a small outline size (12 x 12 mils nominal) and are fully passivated, resulting in low leakage current and high reliability. These varactor chips are intended for assembly in hybrid integrated circuit resonators used in VCOs and analog tuned filters.

### NEW



Skyworks Green™ products are RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, are halogen free according to IEC-61249-2-21, and contain <1,000 ppm antimony trioxide in polymeric materials.



## Absolute Maximum Ratings

| Characteristic                       | Value             |
|--------------------------------------|-------------------|
| Reverse Voltage ( $V_R$ )            | 22 V              |
| Forward Current ( $I_F$ )            | 100 mA            |
| Power Dissipation at 25 °C ( $P_D$ ) | 250 mW            |
| Operating Temperature ( $T_{OP}$ )   | -55 °C to +150 °C |
| Storage Temperature ( $T_{ST}$ )     | -65 °C to +200 °C |

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 Ratings. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void the warranty.

**CAUTION:** Although these devices are designed to be robust, ESD (Electrostatic Discharge) can cause permanent damage. 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.

**Electrical Specifications at 25 °C**

| Part Number | $C_J$ @ 0 V<br>(pF) <sup>(1)</sup> | $C_J$ @ 4 V<br>(pF) |      | $C_J$ @ 20 V<br>(pF) |      | $Q$ @ 4 V<br>50 MHz <sup>(2)</sup> | 1 GHz<br>$R_S$ @ 4 V ( $\Omega$ ) | $I_R$ @17.6 V<br>(nA) <sup>(3)</sup> | Contact<br>Diam. (mils) <sup>(4)</sup> |
|-------------|------------------------------------|---------------------|------|----------------------|------|------------------------------------|-----------------------------------|--------------------------------------|----------------------------------------|
|             | Typ.                               | Min.                | Max. | Min.                 | Max. | Min.                               | Typ.                              | Max.                                 | Nom.                                   |
| SMV2019-000 | 2.3                                | 0.68                | 0.88 | 0.13                 | 0.23 | 500                                | 4.8                               | 50                                   | 2                                      |
| SMV2020-000 | 3.1                                | 1.13                | 1.43 | 0.23                 | 0.33 | 500                                | 4.1                               | 50                                   | 2.5                                    |
| SMV2021-000 | 4.5                                | 1.58                | 1.98 | 0.32                 | 0.44 | 500                                | 2.8                               | 50                                   | 3                                      |
| SMV2022-000 | 7.1                                | 2.48                | 3.08 | 0.48                 | 0.68 | 400                                | 2.2                               | 50                                   | 3.75                                   |
| SMV2023-000 | 10.8                               | 4.28                | 5.28 | 0.78                 | 1.08 | 400                                | 1.4                               | 50                                   | 5                                      |

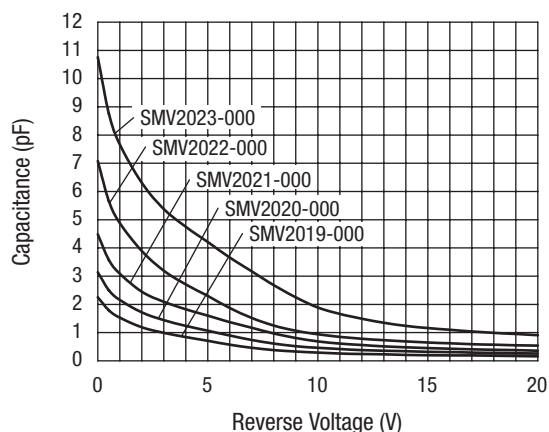
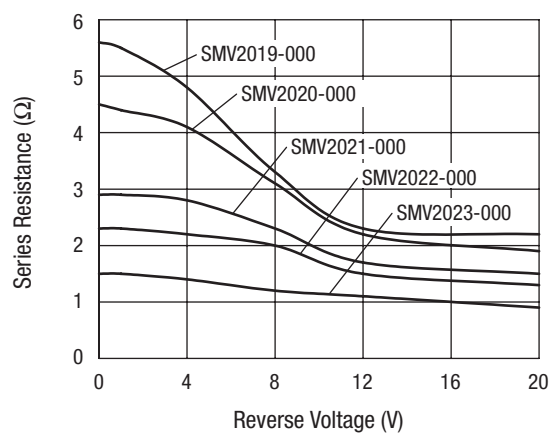
1. All capacitance values specified at 1 MHz.

2. 50 MHz Q calculated from 1 GHz  $R_S$  and 1 MHz  $C_J$ .3.  $V_B$  at 10  $\mu$ A specified at 22 V Min.

4. Outline drawing 149-801.

**Hermetic Packaged Varactor Diodes**

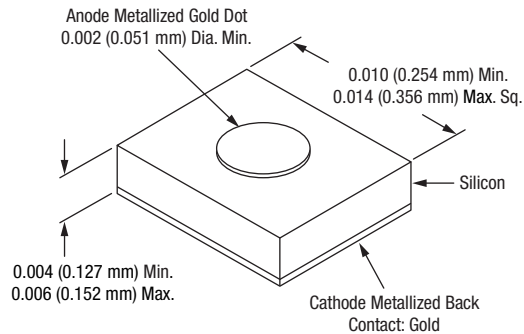
| Stripline<br>240 | Hermetic Pill<br>203 | Stripline<br>219 | Coaxial<br>210 |
|------------------|----------------------|------------------|----------------|
| SMV2019-240      | SMV2019-203          | SMV2019-219      | SMV2019-210    |
| SMV2020-240      | SMV2020-203          | SMV2020-219      | SMV2020-210    |
| SMV2021-240      | SMV2021-203          | SMV2021-219      | SMV2021-210    |
| SMV2022-240      | SMV2022-203          | SMV2022-219      | SMV2022-210    |
| SMV2023-240      | SMV2023-203          | SMV2023-219      | SMV2023-210    |

**Typical Performance Data****Capacitance vs. Reverse Voltage****Series Resistance vs. Voltage @ 1 GHz**

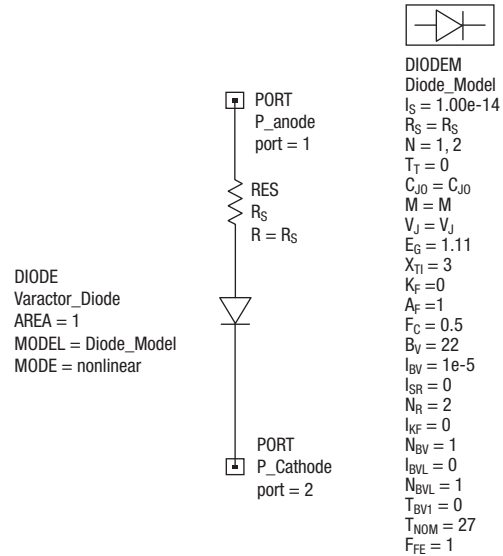
## Typical Capacitance Values

| V <sub>R</sub> (V) | SMV2019<br>C <sub>J</sub> (pF) | SMV2020<br>C <sub>J</sub> (pF) | SMV2021<br>C <sub>J</sub> (pF) | SMV2022<br>C <sub>J</sub> (pF) | SMV2023<br>C <sub>J</sub> (pF) |
|--------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 0                  | 2.25                           | 3.14                           | 4.48                           | 7.08                           | 10.76                          |
| 0.5                | 1.79                           | 2.5                            | 3.57                           | 5.66                           | 8.76                           |
| 1                  | 1.53                           | 2.16                           | 3.09                           | 4.88                           | 7.67                           |
| 2                  | 1.19                           | 1.72                           | 2.45                           | 3.89                           | 6.31                           |
| 3                  | 0.99                           | 1.44                           | 2.09                           | 3.19                           | 5.38                           |
| 4                  | 0.84                           | 1.24                           | 1.83                           | 2.71                           | 4.75                           |
| 5                  | 0.71                           | 1.07                           | 1.6                            | 2.3                            | 4.21                           |
| 6                  | 0.57                           | 0.9                            | 1.37                           | 1.87                           | 3.66                           |
| 7                  | 0.46                           | 0.74                           | 1.17                           | 1.52                           | 3.17                           |
| 8                  | 0.38                           | 0.61                           | 0.97                           | 1.25                           | 2.68                           |
| 9                  | 0.33                           | 0.52                           | 0.81                           | 1.07                           | 2.25                           |
| 10                 | 0.29                           | 0.46                           | 0.69                           | 0.94                           | 1.89                           |
| 11                 | 0.26                           | 0.42                           | 0.61                           | 0.85                           | 1.66                           |
| 12                 | 0.24                           | 0.38                           | 0.56                           | 0.78                           | 1.49                           |
| 13                 | 0.23                           | 0.36                           | 0.51                           | 0.73                           | 1.35                           |
| 14                 | 0.21                           | 0.34                           | 0.48                           | 0.69                           | 1.24                           |
| 15                 | 0.2                            | 0.32                           | 0.45                           | 0.65                           | 1.16                           |
| 16                 | 0.19                           | 0.31                           | 0.43                           | 0.62                           | 1.1                            |
| 17                 | 0.19                           | 0.29                           | 0.41                           | 0.59                           | 1.04                           |
| 18                 | 0.18                           | 0.28                           | 0.39                           | 0.57                           | 0.99                           |
| 19                 | 0.17                           | 0.27                           | 0.38                           | 0.55                           | 0.95                           |
| 20                 | 0.16                           | 0.26                           | 0.36                           | 0.54                           | 0.91                           |

## 149-801



## SPICE Model

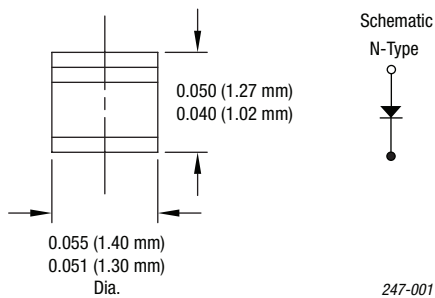


$$C_V = \frac{C_{J0}}{\left(1 + \frac{V_R}{V_J}\right)^M}$$

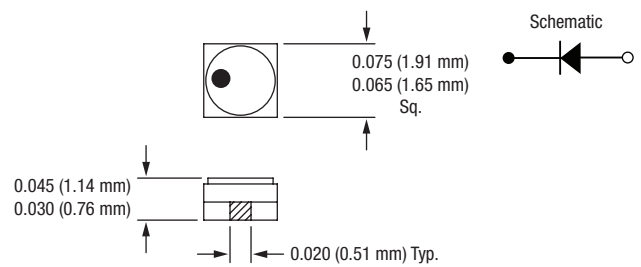
| Part Number | C <sub>J0</sub> (pF) | V <sub>J</sub> (V) | M    | R <sub>S</sub> (Ω) |
|-------------|----------------------|--------------------|------|--------------------|
| SMV2019     | 2.3                  | 3.5                | 1.4  | 4.8                |
| SMV2020     | 3.3                  | 3.6                | 1.3  | 4.1                |
| SMV2021     | 4.5                  | 3.9                | 1.34 | 2.8                |
| SMV2022     | 7.1                  | 4                  | 1.4  | 2.2                |
| SMV2023     | 10.8                 | 4.6                | 1.45 | 1.4                |

SPICE model parameters extracted from measured characteristics may not reflect exact physical or electronic properties. See application note APN1004.

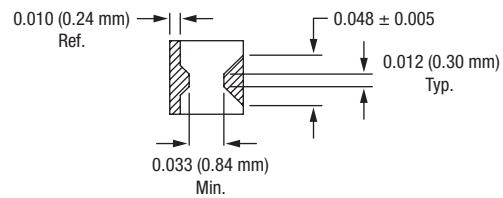
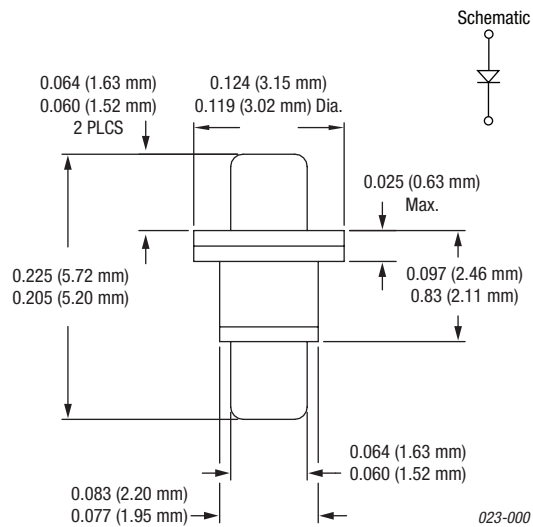
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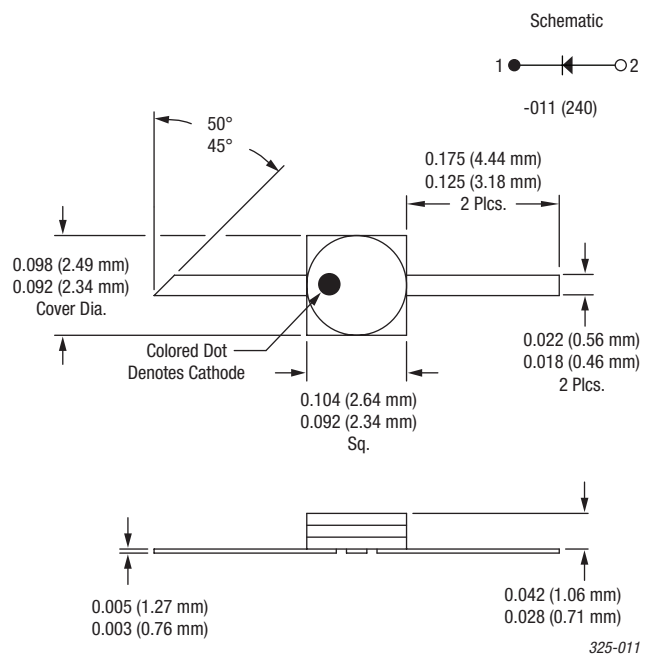


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