MONOLITHIC RC-SNUBBERS FOR 1200 V SiC-POWER MODULES

General Description

A deep trench in silicon filled with SiO₂ or Si₃N₄ as dielectric and doped poly-silicon as electrode forms the capacitor. The bulk silicon can be used to form the series resistor of a passive RC-snubber. The bottom side contact consists of a solder- and sinterable metal stack. The top side contact consists of bondable aluminum, or is solder- and sinterable on request. High voltage versions feature a polyimide passivation.

Features

- Low parasitic inductance (pH) compared to discrete solutions (nH)
- Available as bare-die
- High thermal conduction of Si substrate with low transition resistances
- Detailed understanding of failure mechanism and exact life-time prediction: Elimination of early failing devices
- Outstanding reproducibility and homogeneity of the fabrication process

Advantages

- Higher switching speeds and increased efficiency of the system, e.g. energy converter
- Simplified mounting together with power switches or ICs
- More efficient spread of the thermal power dissipation to the heat sink
- Increased mean-time-to-failure resulting in lower failure rate in the field
- Excellent device tolerances, minor deviations
- Custom designs regarding capacitance, resistance and voltage stability available

Benefits

- Increasing sales volume due to an innovative product with increased system efficiency and SOA
- Less labor time, higher profit due to faster mounting process and less rework
- Secure and reliable systems with reduced downtime in the field
**Device Dimensions**

- Die thickness Z: < 0.68 mm
- Die size X: 1.5 mm – 5.0 mm
- Bond area Y: 1.0 mm – 4.5 mm

*others on request

**Voltage Characteristics**

Fig. 1 shows a typical CV-curve of an exemplary 10 nF / 1 Ω snubber capacitor with a nominal voltage of 900 V.

The ESR change is less than 60% of the nominal ESR at room temperature.

![Fig. 1 Typical CV-curve (900V / 10 nF / 1 Ω)](image)

**Performance Characteristics**

- Climatic category: 40/200/56
- Capacitance range: 1 nF – 20 nF
- Resistance range: 0.2 Ω – 20 Ω
- Tolerance on C: ± 5%, ± 10%
- Tolerance on R: ± 15%
- Operating voltage V₀: up to 900 V
- Test voltage: 1.4 V₀ for 2 sec @ 25 °C
- Insulation resistance: > 2 GΩ @ 900 V DC
- Temperature range: -40 °C – 200 °C
- Δ C(T): < 1% @ Δ T = 100 K
- Δ R(T): 60% @ Δ T = 100 K
- Leakage current at 900 V DC: < 1 μA
- DC breakdown voltage: > 1500 V
- Dissipation power: 100 W @ 1 nF

*others on request

**Frequency Characteristics**

Fig. 4 shows a typical impedance curve of the integrated RC-snubber. Due to the very low ESL, the resonant frequency of the RC-snubber is very high (> 100 MHz).

![Fig. 4 Typical impedance curve (900V / 1.5 nF / 5 Ω)](image)

**Temperature Characteristics**

Fig. 3 shows a typical capacitance and ESR change versus the temperature curve, respectively. The trench capacitor exhibits an excellent temperature behaviour. The capacitance change is less than 1% of the nominal capacitance at room temperature with a temperature change of 100 K.

![Fig. 3 Typical capacitance and ESR change vs. temperature (200V / 10 nF / 1 Ω)](image)

**Die thickness Z**

**Die size X**

**Bond area Y**

2 SiC-based power module with integrated silicon RC-snubbers enabling high switching speeds with SiC power devices.