SILICON INTEGRATED RCD-SNUBBER NETWORKS

General description

Based on our established technology for monolithic RC-snubbers, the silicon integrated RCD-snubber networks combine a deep trench MOS capacitor with a resistor which is formed by the bulk resistance of the silicon substrate. For the RCD-snubber pn-diodes are integrated into the silicon substrate. Different implementations allow for the realization of RCD-snubbers for voltage rise control and for voltage clamping.

Features

- Available as bare die silicon chips
- Whole back side area can be soldered or sintered onto a power electronic substrate (e.g. DBC, lead frame)
- Very small temperature dependence of the capacitor (< 50 ppm/K)
- Extremely low stray inductance (< 100 pH)

Advantages

- Compact module design (one silicon chip replaces three or more discrete passive components)
- Packaging compatible with power semiconductor devices
- Improved thermal connection to heat sink similar to power semiconductor devices
- Reduced voltage overshoots in power modules
- Improved EMC of power module or power switch

Benefits

- Cost savings and improved reliability due to uniform packaging
- More competitive products because of technological advantages
- Increased market volume due to conformity with EMC regulations
Voltage clamping snubber

The voltage clamping RCD-snubber limits the voltage overshoot at a protected device (e.g. a MOSFET), as the following graphic illustrates with SPICE simulation results for a half-bridge power module.

Temperature of the snubber's capacitor and resistor

Capacitance voltage characteristics on a lightly doped silicon substrate

In unipolar operation the capacitance is largely independent of the voltage.

Voltage rise control snubber

The RCD-snubber for voltage rise control limits the voltage slope during the turn-on and turn-off at a protected device. This is shown below in SPICE simulation results of a half-bridge-based DC/DC converter.

Temperature characteristic of the snubber's capacitor and resistor

General characteristics

Nominal voltage | up to 600 V
Temperature range | -40 °C – 200 °C
Climatic category | 40 / 200 / 56
Capacitance range | 0.5 nF – 50 nF (typ.)
Temp. coefficient of the capacitance | ~ 50 ppm/K
Resistance range | 10 mΩ – 10 Ω (typ.)
Temp. coefficient of the resistance | ~ 5000 ppm/K
Blocking voltage of the diode | > 900 V

Capacitance voltage characteristics on a lightly doped silicon substrate

2 Cross-section image of a monolithically integrated capacitor taken by scanning electron microscopy.

3 Silicon integrated snubber chip assembled on a DBC substrate next to active power electronic devices.