

«Saint Petersburg OPEN 2020»



BOOK of ABSTRACTS

**7th International School and Conference
on Optoelectronics, Photonics,
Engineering and Nanostructures**

April 26-30, 2020 • Saint Petersburg, Russia

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7th International School and Conference on
Optoelectronics, Photonics, Engineering and
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dV/dt testing of high voltage 4H-SiC Schottky diodes with different types of metal-polymeric packages

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Abstract. The dV/dt values for 4H-SiC Schottky type diodes with different type packages have been determined experimentally. It is determined that obtained dV/dt values for 4H-SiC Schottky type diodes in small-sized metal-polymeric packages (SOT, QFN) are varying in interval of 670÷990 V/ns.

Introduction

At present the SiC-based high-voltage Schottky type diodes are based on absolutely new generation of power semiconductors, possess the maximal values of breakdown voltage and minimal leakage currents [1]. Earlier, in our previous studies were investigated 4H-SiC Schottky type diodes in respect of their stability to rate of reverse voltage rise dV/dt [2]. In particular, it was established that in 4H-SiC Schottky diodes packaged in standard large-sized package of TO (Transistor Outline) type demonstrate the value of $dV/dt \approx 150\div 200$ V/ns [2]. It is known that the diode package is one of the main elements that determines the characteristics of the diode [3]. Moreover, at present power electronic industry comes down to use of small-sized type of metal-polymeric package such as SOT (Small Outline Transistor), QFN (Quad Flat No-leads) and others [1,3]. However, effect of packaging type on dV/dt characteristics of 4H-SiC Schottky diodes to present are almost not studied, therefore the goal of this work is to study dV/dt characteristics for Schottky diodes in different types of packages.

2. Materials and methods

The used experimental measuring test makes it possible to test on dV/dt characteristics of a SiC Schottky type diodes which was described in detail earlier [2]. The main parameters of tester of dV/dt value in interval from 100 V/ns up to 1000 V/ns at amplitude of pulse of reverse voltage applied through a testing diode $V_A = 0.05\div 0.9$ kV. Analyses of oscillograms has been carried out with used Tektronix MDO3102 oscillograph (bandwidth 1 GHz, refresh rate 5×10^9 s⁻¹).

3. Results and discussion

To prevent experimental errors, the equipment was initially calibrated with a control signal from the equipment by applied amplitude of pulse of reverse voltage (maximal amplitude of 0.7 kV) without diode which is shown in Fig. 1 (curve 1). Then, were tested the following 4H-SiC type Schottky diodes: diode C3D06060F (CREE/Wolfspeed, US) in large-sized TO package type (TO-220-F2); diode 5DS402A (AO «GRUPPA KREMNY EL», Bryansk, Russia) in small-sized SOT package type (SOT-89); diode C3D1P7060Q (CREE/Wolfspeed, US) in small-sized QFN package type (PowerQFN). All obtained dV/dt test results for diodes are shown in Table 1.

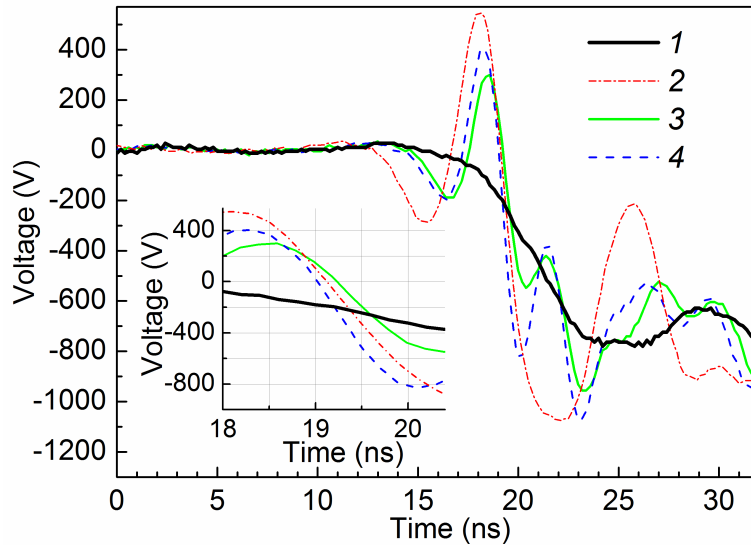


Figure 1. The reverse voltage waveform for diodes (pulse amplitude of 0.7 kV): 1 – without diode, 2 – C3D06060F (Cree), 3 – 5DS402A9 («GRUPPA KREMNY EL»), 4 – C3D1P7060Q (Cree).

The obtained dV/dt value for diode C3D06060F (curve 2 in Fig. 1) in large-sized TO package is equal of 880 V/ns. The testing results for diode 5DS402A (curve 3 in Fig. 1) in small-sized SOT package type is equal of 670 V/ns and for C3D1P7060Q (curve 4) in small-sized QFN package is 990 V/ns.

Table 1. dV/dt results for testing of 4H-SiC Schottky diodes with different packages type.

No.	Package type	Diode's type	Package dimensions (mm)	dV/dt (V/ns)
1	TO-220-F2	C3D06060F	10.3×16.07	880
2	SOT-89	5DS402A	4.6×2.6	670
3	QFN 3.3	C3D1P7060Q	3.3×3.3	990

4. Conclusions.

The obtained results indicated that the package's size miniaturization not lead to dV/dt characteristics degradation and dV/dt values for small-sized metal-polymeric packages type (SOT, QFN) not only are comparable with large-sized TO package type, but in case of QFN package type the dV/dt results are greater than in case of the large-sized TO package.

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