

Analysis of Silicon Controlled Rectifier-Based Electrostatic Discharge Protection Circuits with Electrical Characteristics for the 5V Power Clamp

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Abstract : This paper analyzed the SCR (Silicon Controlled Rectifier)-based ESD (Electrostatic Discharge) protection circuits with the turn-on time characteristics. The structures are the LVTSCR (Low Voltage Triggered SCR), the ZTSCR (Zener Triggered SCR) and the PTSCR (P-Substrate Triggered SCR). The three structures are for the 5V power clamp. In general, the structures with the low trigger voltage structure can have the fast turn-on characteristics than other structures. All the ESD protection circuits have the low trigger voltage by using the N+ bridge region of LVTSCR, by using the zener diode structure of ZTSCR, by increasing the trigger current of PTSCR. The simulation for the comparison with the turn-on time was conducted by the Synopsys TCAD simulator. As the simulation results, the LVTSCR has the turn-on time of 2.8 ns, ZTSCR of 2.1 ns and the PTSCR of 2.4 ns. The HBM simulation results, however, show that the PTSCR is the more robust structure of 430K in HBM 8kV standard than 450K of LVTSCR and 495K of ZTSCR. Therefore the PTSCR is the most effective ESD protection circuit for the 5V power clamp.

Keywords : ESD, SCR, turn-on time, trigger voltage, power clamp

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