Analysis and Measurement of Capacitance Characteristics of a Novel Light-Controlled Dual-Directional Gate Silicon-Controlled Rectifier

© *F. Yan*[1], *Y. Wang*[1], *X.L. Jin*[1,¶], *Y. Peng*[2], *J. Luo*[2], *J. Yang*[3]

[1] School of Physics and Electronics, Hunan Normal University,
Changsha, 410081 China
[2] School of Mechatronic Engineering and Automation, Shanghai University,
Shanghai, 200444 China
[3] School of Western Ontario University,
London, ON N6A3K7 Canada

[¶] E-mail: jinxl@hunnu.edu.cn

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With the continuous development of optoelectronic devices, parasitic capacitance of electrostatic protection device in the optoelectronic control circuit has become an important factor affecting its response speed. This work designs and manufactures a novel light-controlled dual-directional gate silicon-controlled rectifier (LDGSCR) to study the relationship between light and parasitic capacitance based on 0.18-μm bipolar — complementary metal-semiconductor — double-diffused metal-oxide semiconductor process. The capacitance characteristics of LDGSCR is predicted and verified based on basic principles of the device, 3D device simulation, and capacitance–voltage characteristic $C(V)$ test result. The results show that parasitic capacitance of LDGSCR is affected by both light and bias voltage due to selectivity of J_2 junction to light wavelength. The parasitic capacitance of LDGSCR is interestingly divided into three stages of change as voltage increases under light, and the magnitude of capacitance increase varies with the change of light wavelength. In addition, the influence of darkness and light intensity on the parasitic capacitance of LDGSCR is studied. Finally, an optimal adjustment method that balances design windows of novel device and operating frequency of circuit is proposed. This work provides suggestions for the study of capacitance characteristics of light-controlled electrostatic protection devices.

Keywords: optoelectronic control circuit, light-controlled, SCR device, capacitance characteristics.

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