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United States Patent [19] Huang

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[54] SEMICONDUCTOR DEVICE AND CONTROL METHOD

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[58] Field of Search **257/212, 110, 257/132, 133, 146, 172**

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[57] ABSTRACT

A semiconductor device which reduces the turn-off time and the accompanying switching loss in a switching semiconductor device in which conductivity modulation is used to provide a low ON-state voltage. The conductivity modulation is provided by injection of minority carriers. A minority carrier injection-control structure is provided in part of a semiconductor device to change the polarity of a voltage applied to a gate electrode to start or stop the injection of minority carriers. During the ON-state, minority carriers are injected to obtain a low ON-state voltage, while during the OFF-state, the injection of minority carriers are stopped and a channel for majority carriers is formed to eliminate the accumulation of excess carriers and to accelerate discharge, thereby reducing the turn-off time and thus the switching loss.

17 Claims, 5 Drawing Sheets

