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A half-bridge driver circuit including a lower drive module and a floating upper drive module for driving respective external upper and lower power transistors of a high voltage half bridge is contained in an integrated circuit chip which includes an on-chip bootstrap diode emulator for charging an external bootstrap capacitor that powers the upper drive module. The upper drive is accommodated in an insulated well and the diode emulator includes as its main current carrying element, an LDMOS transistor formed along the periphery of the well. The LDMOS transistor is driven into a conducting state at the same time the lower power transistor is driven into a conducting state. A clamp and current source solidly bias the backgate of the LDMOS while limiting the current drawn by a parasitic transistor attached to the backgate during startup of the LDMOS.

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