Isolated Ultrafast Gate Driver Architecture

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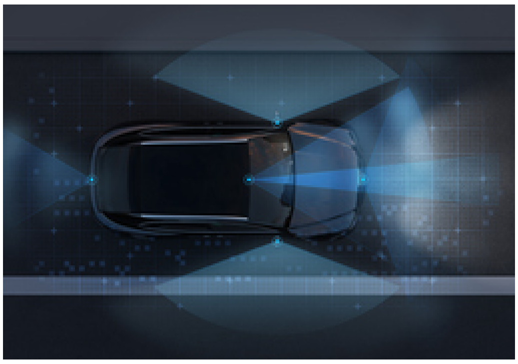

OVERVIEW

Architecture for an isolated, variable duty cycle, ultrafast gate driver and hardware

- A gate voltage slew rate of 12 GV/s with rise and fall times below 260/ps
- Relevant for space, automotive (Lidar), and power electronics (VHF) applications

BACKGROUND

Ultrafast and isolated gate drivers are needed in LiDAR for range accuracy and resolution, in very-high- frequency (VHF) for minimizing loss and expanding the range of operation, and in space applications for increasing reliability with isolation. With these capabilities, pulse and VHF power electronics can be designed to operate at higher frequencies, allowing for smaller, lighter, and more efficient systems. Still, challenges in ultrafast gate driver design include maximizing fast switching transitions for narrow pulses and higher frequency as defined by an ultrafast slew rate. The gate driver must also reside at the same potential as the power device, so the device should be set up with isolation between the controller and gate. The devices require variable frequency and duty cycle for current and voltage modulation and adjusting pulse width, with some methods dependent upon automatic DC restoration for duty-cycle preservation. So, a need exists for improved gate drivers that optimize these characteristics.

INNOVATION

Researchers have developed an architecture for an isolated, variable duty cycle, ultrafast gate driver and hardware capable of achieving a gate voltage slew rate of 12 GV/s with rise and fall times below 260/ps. This device is the fastest isolated gate drive architecture discovered to date, with magnetic isolation that ensures common-mode transient immunity and positive feedback which provides automatic DC restoration to preserve variable duty cycles. While performing at a

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Category

Hardware

Engineering & Physical Sciences

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slew rate of 12 GV/s, the gate driver can operate at 100 MHz with a gating loss of 108 mW per switch at a driving voltage of 5 V. The device can therefore drive a pulse power device with a slew rate of greater than 37 GV/s, improving total efficiency by 8%. Further refinements on this approach should prove useful in applications that require high-frequency switching, such as power inverters, motor drives, and switched-mode power supplies.