Circuit of Pulsed Laser Diode

Article Overview

A pulsed laser diode circuit requires a fast-switching driver, energy storage capacitor, and careful control of pulse width and peak current to safely generate high-power optical pulses.

Key Components and Principles

1. Laser Diode Characteristics Pulsed laser diodes are low input-impedance devices that require high peak currents for very short durations, often in the range of several amperes to tens of amperes, depending on the desired optical output power and pulse width . The pulse width is typically in the nanosecond range, and the duty cycle must be very low to prevent thermal damage to the diode . 2. Energy Storage and Pulse Delivery A bypass or storage capacitor (C2) is critical. It stores energy and delivers the required current to the laser during the pulse, especially when the input pulse is off. The capacitor value can be calculated using: C = Peak Current x Pulse Width / Vc, where Vc is the voltage across the capacitor . Placement is crucial: it should be as close as possible to the laser driver with minimal inductance in the path to ensure fast pulse delivery . 3. Switching Device High-speed transistors or GaN FETs are commonly used to switch the current through the laser diode. GaN devices are preferred for nanosecond pulses due to their high switching speed, low on-resistance, and ability to handle tens to hundreds of amps without degradation . The transistor must be chosen to handle the peak current and voltage requirements of the pulse. 4. Pulse Shaping and Control Pulse width and repetition rate are controlled using a gate driver and timing circuitry, often implemented with an FPGA for precise control . Additional circuits like pulse narrowing networks or resonant circuits can help achieve sub-5 ns pulse widths and fast channel switching. 5. Power Supply Considerations A boost or linear power supply provides the necessary voltage to charge the capacitor and drive the laser. The supply must be stable and capable of delivering the required energy without introducing noise that could distort the pulse . 6. Layout and Parasitics PCB layout is critical. Minimize trace inductance and resistance, place bypass capacitors close to the driver, and use large power planes for VDD and GND to ensure fast current delivery . Even small parasitic inductances can significantly distort nanosecond pulses.

Practical Example

For LiDAR applications, a typical design might include:

o Laser diode: 905 nm, peak current 30-50 A, pulse width 1-50 ns
o GaN FET driver: capable of switching >100 A in nanoseconds
o Capacitor: sized to supply the peak current for the pulse width
o FPGA: controls pulse timing and repetition rate (up to 1 MHz)
o Pulse shaping network: ensures narrow, clean pulses for high-resolution detection .

Summary

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Designing a pulsed laser diode circuit involves balancing peak current, pulse width, duty cycle, and thermal limits. Key elements include a fast-switching transistor or GaN FET, a properly sized energy storage capacitor, precise timing control, and careful PCB layout to minimize parasitic effects. This ensures high optical output while maintaining diode reliability and safety.

To understand the basic building blocks of a semiconductor laser driver, please refer to our article on continuous

One final advantage of using an active LiDAR configuration (where the FET switching causes directly the diode to switching) is that it

This article will cover the following topics: First, there will be short discussion of lidar, laser diodes, and pulse requirements. This will

This paper proposes a nanosecond-level pulse laser diode array drive circuit for LiDAR, primarily aimed at addressing

This paper mainly introduces a design circuit and control method of pulse power supply for high-power semiconductor laser diode

The laser driver circuit as shown in figure 4 is meant to be used to control the current of the laser diode. The design

The laser can achieve high peak power pulse output by electro-optic Q-switch technology. Aiming at the problem of how to achieve Q

In laser rangefinding via time-of-flight inexpensive pulsed laser diodes have become the standard. In order for the

In this paper, a mixed-mode control of multiple interleaving parallel circuits is proposed.

Laser currents on the order of several tens of amperes are used to create these light pulses,

Pulsed laser diodes have their roots in military applications. They are ideally suited to

In this article, we will delve into the intricacies of pulsed laser diode driver circuit layout for

Introduction to Laser Diode Drivers in Lidar Systems Lidar (Light Detection and Ranging) systems have

become

Photodectors suitable for studying pulsed infrared LEDS and visible diode lasers include high-speed Si PIN diodes with fast rise and

Most modern pulsed laser systems require versatile laser diode drivers. A state-of-the-art pulsed laser driver should

Hence, an APC circuit is typically employed to ensure that the power output remains unchanged as the ambient

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