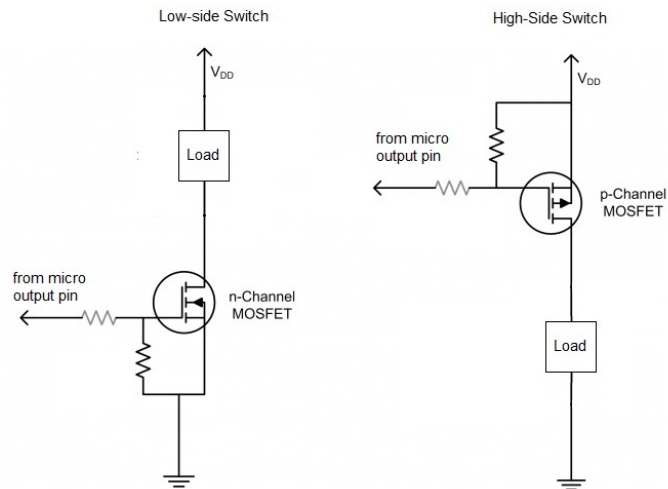


High Side vs. Low Side Switching

1 Introduction

In power electronics and circuit design, switching transistors such as MOSFETs and IGBTs are commonly used to control the flow of current through a load. These switches can be configured in two fundamental ways: high side and low side switching. The choice between high side and low side switching depends on the application requirements, the nature of the load, and safety considerations.

2 High Side vs. Low Side Switching



2.1 High Side Switching

High side switching refers to a configuration where the switching device (e.g., MOSFET, IGBT) is placed between the power supply (positive voltage rail) and the load. When the switch is turned on, current flows from the power supply, through the switch, and into the load. The load is connected to the ground.

- **Gate Control:** In high side switching, the gate of the switching device must be driven to a voltage higher than the supply voltage to turn on the switch. This often requires a gate driver circuit with a bootstrap capacitor or a dedicated high side driver.
- **Common Applications:** High side switching is often used in applications where the load must be connected to ground, such as in motor control, half-bridge and full-bridge circuits, and buck converters.
- **Safety Considerations:** Since the load is connected to ground, high side switching can provide a safer operating condition, especially in cases where the load might be exposed to human contact.

2.2 Low Side Switching

Low side switching refers to a configuration where the switching device is placed between the load and ground. When the switch is turned on, current flows from the power supply, through the load, and then through the switch to ground. The load is connected to the positive voltage rail.

- **Gate Control:** In low side switching, the gate of the switching device is referenced to ground, making it easier to control the switch directly from logic-level signals without the need for a special gate driver circuit.
- **Common Applications:** Low side switching is commonly used in applications where simple and cost-effective gate drive circuitry is required, such as in LED drivers, relay controls, and basic power switches.
- **Safety Considerations:** Low side switching may expose the load to the full supply voltage even when the switch is off, which can be a safety concern in some applications.

3 Choosing Between High Side and Low Side Switching

3.1 Application Requirements

The choice between high side and low side switching depends on the specific requirements of the application:

- **Load Type:** If the load needs to be grounded for safety reasons, high side switching is preferred. This is common in motor control applications, where the motor casing is grounded for safety.
- **Gate Drive Complexity:** Low side switching is generally simpler to implement because the gate drive circuitry can be referenced to ground. High side switching requires more complex gate drive circuits, such as bootstrap circuits, to raise the gate voltage above the supply rail.

- **Switching Speed:** Both high side and low side configurations can achieve high switching speeds, but the complexity of the gate drive circuit may affect the overall design. Low side switching, with its simpler gate drive requirements, can be advantageous in high-speed applications.
- **Efficiency and Cost:** Low side switching is often more cost-effective due to the simpler gate drive requirements. High side switching may require additional components, increasing the overall cost.
- **Circuit Topology:** The topology of the circuit may dictate the choice of switching. For example, in a buck converter, high side switching is essential for regulating the output voltage.

3.2 Examples

- **High Side Switching:** Used in DC motor control, where the motor needs to be connected to ground, and the control switch regulates the power supplied to the motor.
- **Low Side Switching:** Used in LED drivers, where simple control from a microcontroller is required, and the LEDs can be directly connected to the positive rail with the switch controlling the path to ground.

4 Conclusion

The decision to use high side or low side switching depends on various factors, including the load requirements, safety considerations, and gate drive complexity. Understanding the trade-offs and specific application needs is crucial for selecting the appropriate switching configuration, ensuring efficient and safe operation in power electronics circuits.