Vgs Testing of Silicon Carbide (SiC) Top-Side Transistors Made Easier using Micsig Optical Isolated Probe

This case study clearly shows how challenging accurate Vgs measurement can be in high-speed SiC applications when using traditional differential probes. The use of Micsig's optical isolated probe effectively eliminated false oscillations, provided clean and reliable waveforms, and helped engineers verify real device behaviour with confidence. It's a strong example of how proper measurement tools can significantly reduce debugging time and improve the reliability of SiC and GaN power designs.

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Third-generation semiconductor materials, particularly silicon carbide (SiC) and gallium nitride (GaN), show enormous market potential in electric vehicles, renewable energy, industrial power supplies, military and aerospace, fast-charging technology, wireless communications, and consumer electronics. These materials offer advantages such as high thermal conductivity, high breakdown field strength, high saturated electron drift velocity, and high bonding energy, enabling them to perform exceptionally well under harsh conditions such as high temperature, high voltage, high frequency, and radiation resistance. While these materials offer significant performance advantages, their high switching speeds also present significant challenges for test and measurement.

Introduction In practical applications, measuring the Vgs of silicon carbide high-side transistors (SiC high-side transistors) presents a technical pain point. The rapid switching speed of SiC devices results in significant harmonic energy in their high-frequency harmonic components. During development and debugging, Vgs signal oscillations are often observed, leaving engineers unable to verify the signal's authenticity. This requires test equipment with high common-mode rejection capabilities even at high frequencies.

Test Example

● Tested equipment: A high-power DC regulated power supply project of a major power supply manufacturer in Guangdong

● Test point: Full-bridge circuit upper tube voltage waveform (Vgs) & upper tube Id current

● Customer pain point: When using silicon carbide devices to develop power products, using traditional differential probes to measure the Vgs of the upper tube, the signal oscillates, making it difficult to analyze and locate the problem

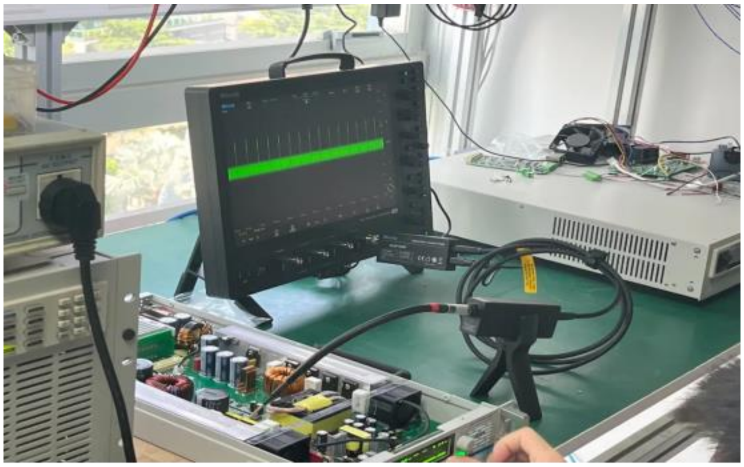
Test Solutions

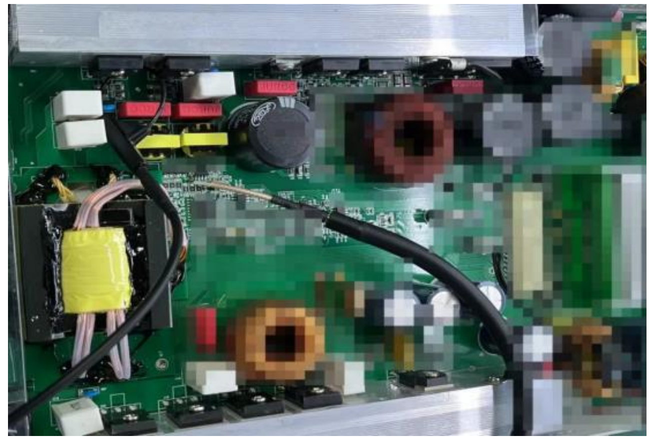
Optical isolated probe MOIP series MOIP1000P

High-resolution oscilloscope MHO3 series MHO3-5004

Flexible current probe RCP series RCP600XS

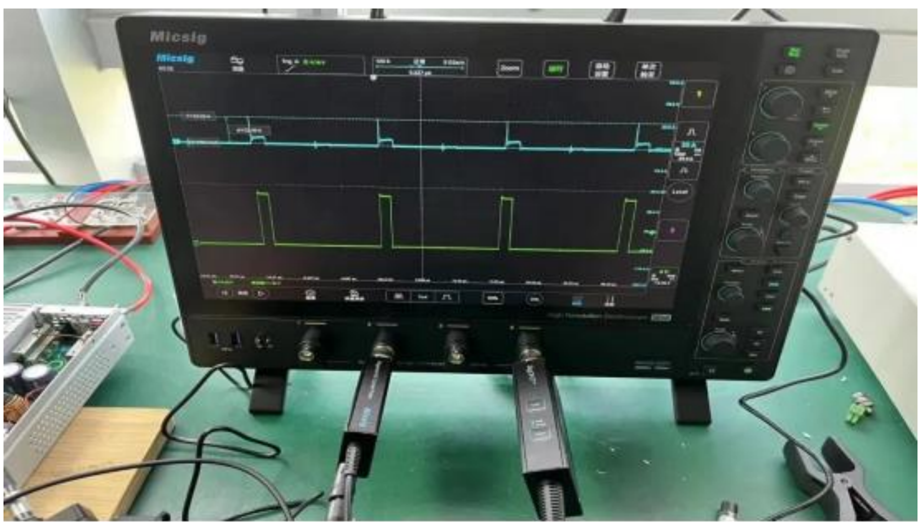
Setup Below picture shows the MHO3 series high-resolution oscilloscope MHO3-5004, the MOIP series optical isolation probe MOIP1000P, the RCP series flexible current probe RCP600XS, and the power supply under test.





In the test point connection diagram, the optical isolation MOIP1000P uses MMCX coaxial cable to connect to the upper tube Vgs signal, and the Rogowski coil RCP600XS passes through the chip pin to continuously monitor the upper tube Id current signal

In the following oscilloscope display of the upper tube Vgs and Id test waveforms, channel 4 (green waveform) shows the upper tube Vgs signal, and channel 2 (blue waveform) shows the upper tube Id current signal.



Before we found the Micsig optical isolated probe MOIP1000P**, we used differential probes for testing. The test waveform did show some oscillation when the upper tube was turned on and off**. Due to lack of experience, our engineers did not suspect a problem with the test equipment and **spent a lot of time modifying the circuit and adjusting parameters, but the oscillation problem still existed**. Then we used the Micsig optically-isolated probe MOIP1000P**. Initially, we just wanted to try it out, but we found the actual results were very good** . The waveforms at the test points were very similar to our theoretical ones, which solved a major problem in our R&D.

Conclusion Micsig's MOIP1000P optical isolated probe, based on its proprietary SigOFIT™ technology, boasts a common-mode rejection ratio (CMRR) of up to 180dB, exceeding 100dB at 1GHz. This enables more efficient circuit testing and verification of power supply designs using silicon carbide and gallium nitride as core components. It enables engineers to capture the actual VGS voltage waveform of the high-side transistor (HSDT), helping them accurately analyze whether their circuit design meets requirements and ensure high performance and reliability. This not only improves product quality but also strengthens market competitiveness. Micsig's innovative technologies and solutions provide strong support to more power supply design companies, driving technological advancement and development in the industry.