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White Paper

ACPL-W346 and ACPL-339J
SiC MOSFET Gate Drive Optocouplers

Introduction

Silicon Carbide (SiC) power semiconductors are rapidly emerging into the commercial market. They deliver several benefits over conventional Silicon-based power semiconductors. SiC MOSFETs can improve overall system efficiency by more than 10% and the higher switching capability can reduce the overall system size and costs. The technical benefits coupled with lower costs have increased the fast adoption of SiC power semiconductors in applications like industrial motor control, induction heating, industrial power supplies, and renewable energy.

Broadcom® gate drive optocouplers are used extensively in driving silicon-based semiconductors like IGBT and power MOSFETs. Optocouplers are used to provide reinforced galvanic insulation between the control circuits from the high voltages and the power semiconductors. The ability to reject high common mode noise (CMR) will prevent erroneous driving of the power semiconductors during high frequency switching. This paper describes how the next generation of gate drive optocouplers can be used to protect and drive SiC MOSFETs.

Advantages of SiC MOSFET

Silicon carbide is a wide bandgap (3.2 eV) compound made up of silicon and carbon. Wide-bandgap SiC, besides being able to operate at high voltage, frequency and temperature, exhibits on-resistance and gate charge by an order of magnitude lower than silicon material. In an evaluation conducted by Cree Inc. to compare the second generation 1200V/20A SiC MOSFET with a silicon high speed 1200V/40A H3 IGBT using a 10 kW hard-switching interleaved Boost DC/DC converter. The results showed that even with five times the switching frequency, the SiC solution was able to achieve a maximum efficiency of 99.3% at 100 kHz, reducing losses by 18% from the best efficiency of the IGBT solution at 20 kHz.

Cree’s recent release of the C2M family of MOSFETs provide engineers a wide range of competitively priced 1200V and 1700V SiC MOSFETs for a wide range of applications. Cree has been able to bring the cost down significantly while providing improved switching performance and lower Rds (on). Increasing the switching frequency can significantly reduce the size of the inductor. The lower conduction and switching losses allow engineers to reduce the size of the heat sink or potentially remove fans and move to passive cooling solutions. The smaller inductor and heat sink can reduce the system size significantly. Although a SiC semiconductor costs more than Si, the overall system BOM costs can be lower than Si technology by 20%.

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