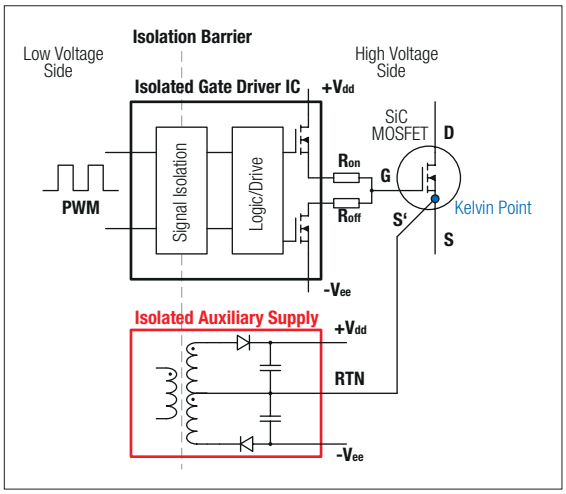
Power Magnetics for SiC-MOSFET Gate Drivers

Gate Driver System for SiC-MOSFET

Isolated Gate Driver systems control the turn-on and turn-off of power semiconductor devices (like SiC-MOSFET) in switching applications.

They provide:

- Safety and operating galvanic isolation
- Optimal gate-source drive voltage levels
- Fast drive current
- Power required for the switching events



The gate drive IC controller and the auxiliary power supply with bipolar output are configured and connected to the SiC-MOSFET as shown in the image

Fast switching times

High efficiency

Smaller solution and lower system costs

The new WE-AGDT auxiliary gate drive transformer for SiC-MOSFET: www.we-online.com/we-agdt

SiC-MOSFETs for State-of-the-art, Present and Future Power Electronics Applications

Principal Characteristics of SiC-MOSFETs

- Extremely high switching speed
- Very high breakdown voltage
- Very low conduction resistance
- High temperature rating
- Robust and reliable operation

Advantages of SiC-MOSFETs in Power Converters

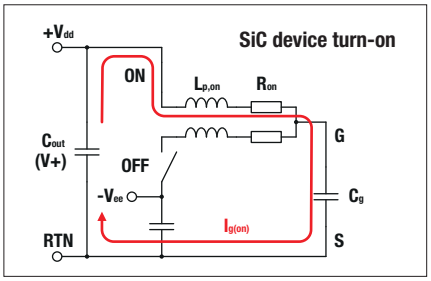
- Higher efficiency
- Higher output power
- Higher operating voltage
- Smaller solution size
- Lower system cost

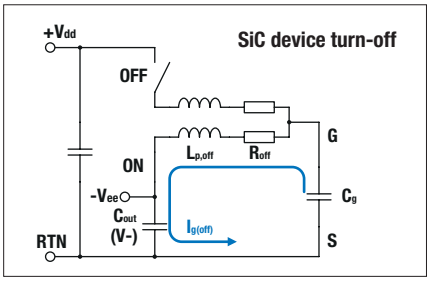
Challenges for driving SiC-MOSFETs

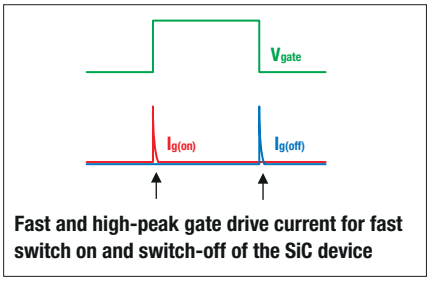
- Very fast current sourcing
- Rugged galvanic isolation
- Spurious turn-on (e.g. Miller effect)
- Gate voltage ringing and EMI
- Control signal distortion and CMTI

SiC-MOSFETs are Made to Switch Fast !

In order to turn on and off a SiC-MOSFET, it is required to charge and discharge its parasitic gate capacitance.
A very low parasitic inductance of the gate current loop, especially at the source terminal of the device, helps to achieve a very fast and well-controlled switching transition with low EMI ringing. Below the equivalent gate current loops during the switching transitions.







Fast and high-peak gate drive current for fast switch on and switch-off of the SiC device

(*) see Reference Design Document RD001 for more information

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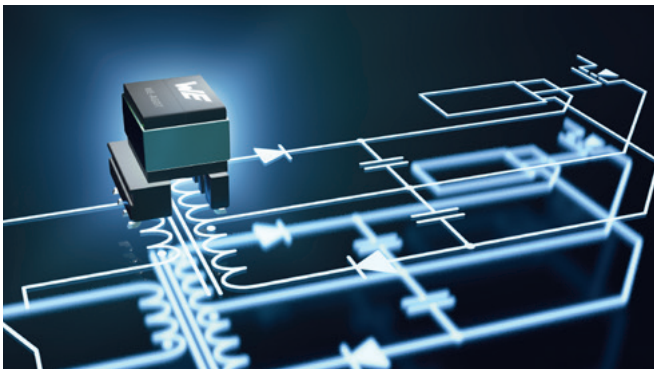
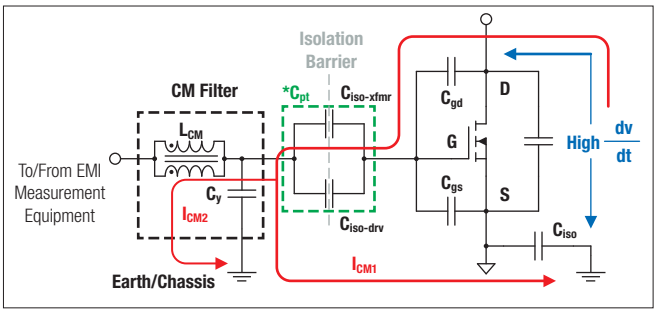
Isolation Barrier Parasitic Capacitance: Common-mode Transient Immunity (CMTI) and EMI Performance

Common-mode Transient Immunity (CMTI) (measured in kV/us or V/ns), is an indication of the maximum dV/dt which can be tolerated across the isolation barrier before malfunction of the gate driver system occurs, due to excessive distortion of the gate drive control signals.

- SiC-MOSFETs switch extremely fast, helping to increase efficiency and reduce system size and cost.
- Fast switching speed causes high dV/dt to appear across the isolation barrier parasitic capacitance (Gate driver IC and auxiliary supply transformer).
- Common-mode displacement currents are generated.
- A lower parasitic capacitance reduces these displacement currents, helping to achieve a higher CMTI rating and better EMI performance.
- **It is critical to minimize the transformer interwinding capacitance in fast-switching SiC-MOSFET gate drive applications.**



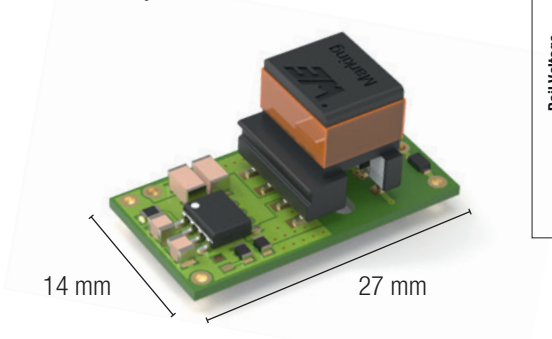


Example EMI common-mode current concept schematic

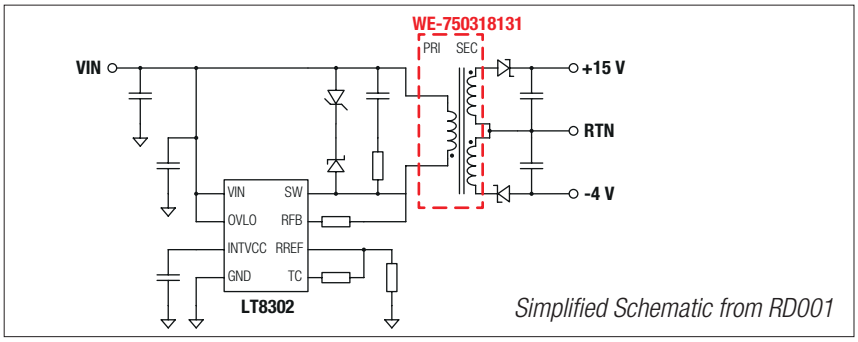
Würth Elektronik Reference Design RD001

6W Isolated auxiliary supply for SiC-MOSFET and IGBT Gate Driver systems.

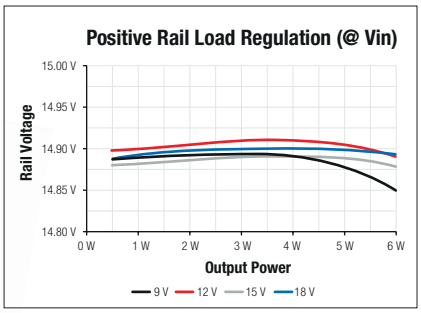
- Extremely compact solution
- Wide input voltage PSR flyback converter
- Bipolar output voltage: +15 V / -4 V
- Output power up to 6 W
- Efficiency over 86 %
- Easy to integrate into the Gate Driver system
- PCB layout and fabrication files available

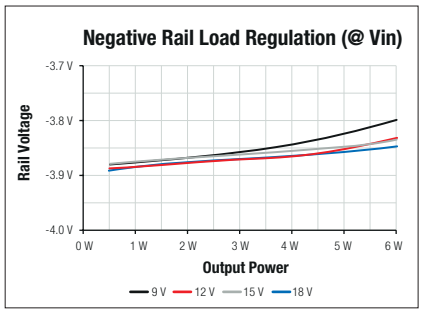


Two compact board design variants are provided: One single-sided and one double-sided.



Simplified Schematic from RD001





Our reference design 6W Isolated auxiliary power supply for SiC-MOSFET gate driver: www.we-online.com/RD001