

Optimization of Gate Current Shaping to Enhance Switching Performance of SiC-MOSFETs

Lan Fang, Chouhdary Junaid Arshad, Pushkar Kulkarni

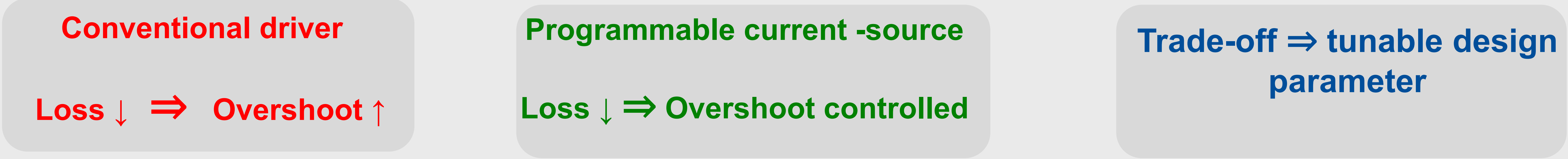
INTRODUCTION AND BACKGROUND

- Motivation**
Conventional gate drivers face a fixed switching loss vs. overshoot trade-off.
- Proposed Solution**
Programmable Bosch current-source gate shaping driver to enable phase-dependent switching control.

DESIGN METHODOLOGY

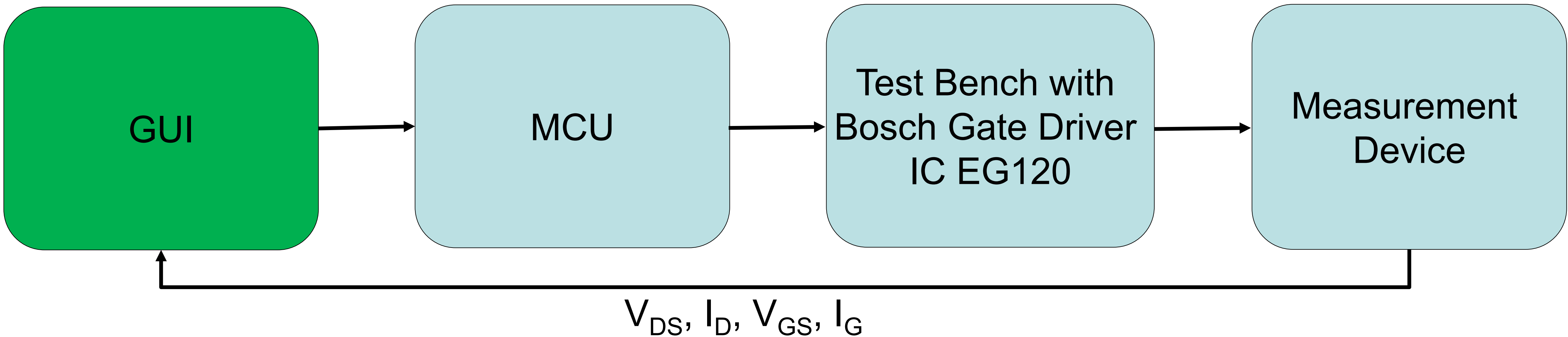
Technology	Gate Current Action	Main Benefit	Typical Use Case
Voltage-Source Driver	Gate current indirectly determined by external R _G	Fixed switching behavior	Conventional converters
Constant Current Source Driver(CC)	Constant gate current throughout the switching event	Direct gate-charge control	Reference operating mode
1-Stage: (GS-1) Energy Optimized	Increase gate current mainly during dv/dt	Fast turn-on and turn-off event	PCS/Data Center PSU
2-Stage: (GS-2) Performance Optimized	Increase gate current during both di/dt and dv/dt phases	Performance optimization	High-density converters
3-Stage: (GS-3) SOA-Optimized	Selectively reduce gate current during di/dt	Overshoot and SOA margin optimization	Higher-parasitic layouts

KEY IDEA



Current shaping directly controls gate charge, while voltage-source drivers influence it indirectly via R_G.

AUTOMATED DPT OPTIMIZATION PLATFORM

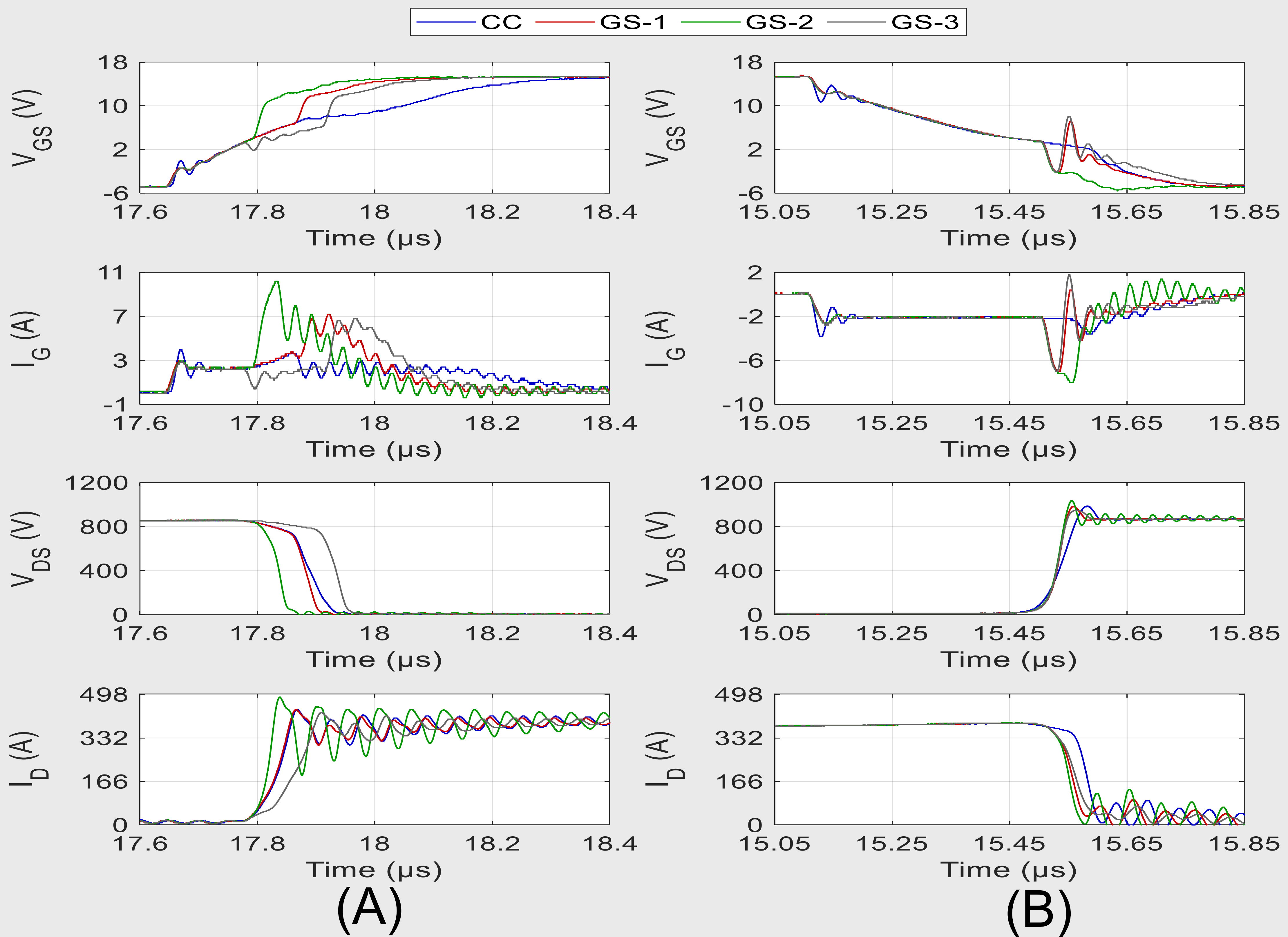


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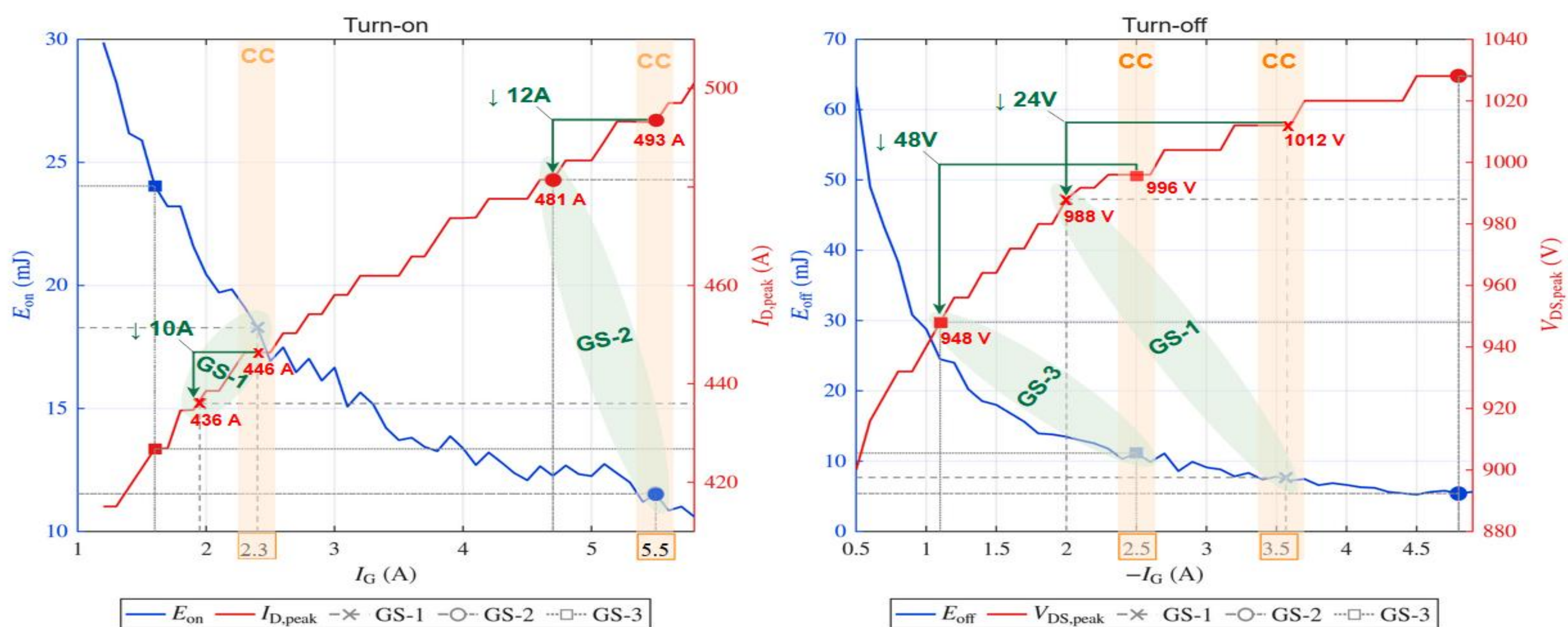
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RESULTS & DISCUSSION

CHARACTERISTICS COMPARISON AT 850 V AND
400 A (A) SWITCH-ON (B) SWITCH-OFF



COMPARISON OF GS VS.
CC AT 850V, 400A



Phase-dependent gate current control independently optimizes di/dt and dv/dt during switching.

CONCLUSION

KEY RESULTS COMPARED TO CC BASELINE

↓ **47%**

Switch-on energy
at 850 V / 400 A

↓ **57%**

Switch-off energy
at 850 V / 400 A

Up to **40%** ↓

Overshoot reduction
SOA maintained

One programmable gate-driver platform enabling efficiency, performance and reliability optimization across different SiC applications.