A Full Power Emulation Platform for Evaluating Power Semiconductors

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Proposed Full Power Emulation Platform

Existing Cascaded Boost/Buck SCRC Circuit

Proposed Full Power Emulation Platform

Operation Rules in ZVS mode

Operation Rule of Proposed Full Power Emulation Platform in Hard Switching Mode

Circuit Equations in ZVS mode

The operation of each switch is exactly symmetrical. There are two degrees of freedom – frequency (freq) and duty cycle of inductor voltage (duty), to control the inductor RMS current (iRMS) and switching off current (iSwitching) of DUT independently.

ZVS Boundary

duty > \( \frac{\text{freq} \times L_{\text{load}}}{\text{iRMS}} \)

Waveforms in ZVS Mode @ 500kHz, iRMS=13A, VBUS=400V

Theory Experimental Verification

Power Supply Output Current

Waveforms in ZVS Mode @ 500kHz, iRMS=13A, VBUS=400V

Waveforms in Hard-switching Mode @ 1MHz, iRMS=20A, VBUS=400V

Conclusion

The operation principles of the full-bridge energy recirculation and storage circuit are explored and extended to evaluate power semiconductors under both soft switching and hard switching conditions. An IMS-based 120 A/ 650 V GaN power module is evaluated by proposed full power emulation platform. A strong correlation has been shown between simulation and experiment results under all test conditions.