Solid-State Transformers (SSTs) for AI Infrastructure Power Distribution

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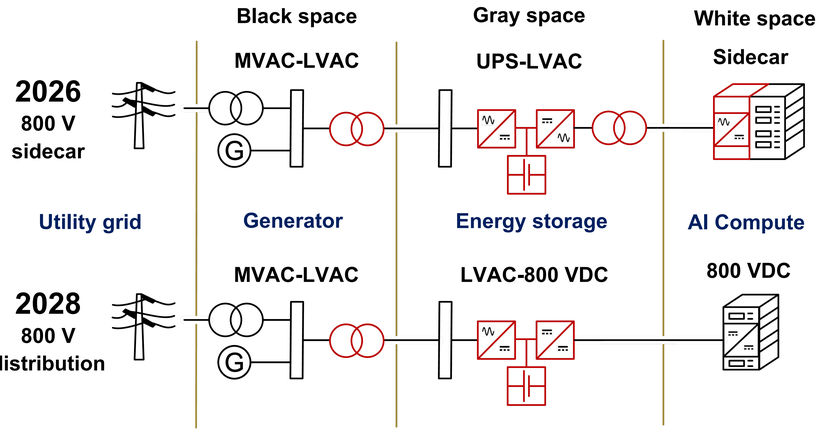
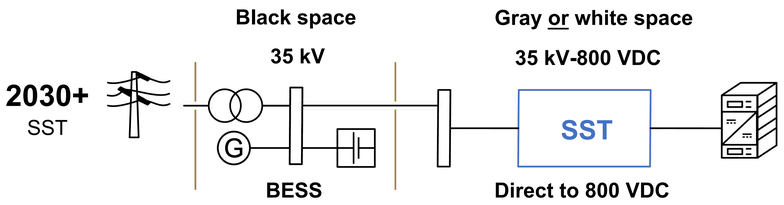
Background and Motivation

1 Data center power distribution



► **High conversion complexity** ► **Poor scalability for future AI**

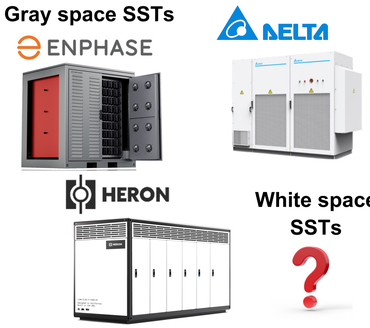
2 Industry trending toward SST integration



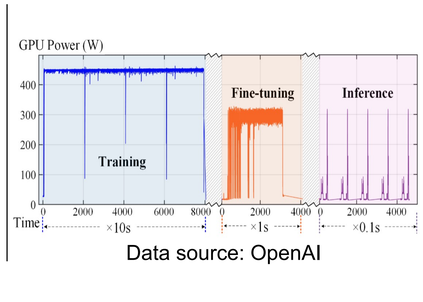
► **Minimized power conversion complexity with fewer stages** ► **Highly scalable with the *appropriate* SST technology**

Next-Generation SST Challenges

Gray space SSTs



White space SSTs

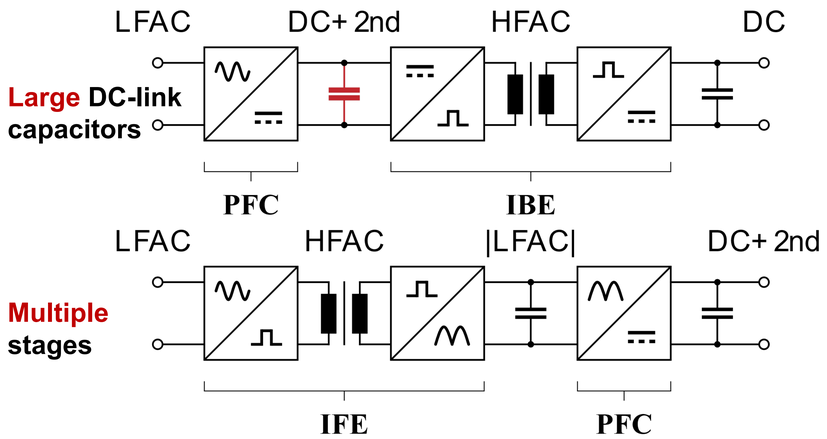


1 **Existing SSTs are bulky**—conventional power-cells have poor power density

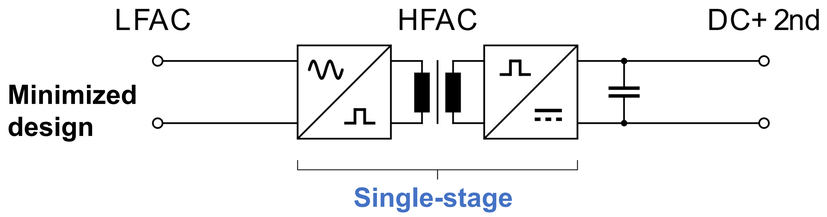
2 **Rapid AI load transients**—challenge to control single-rack >1 MW load swings

Addressing SST Design Challenges

1 Conventional multi-stage power-cells



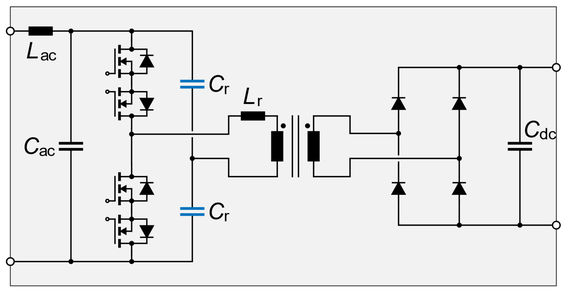
2 Compact and efficient SST single-stage



Novel Power-Cell Topology

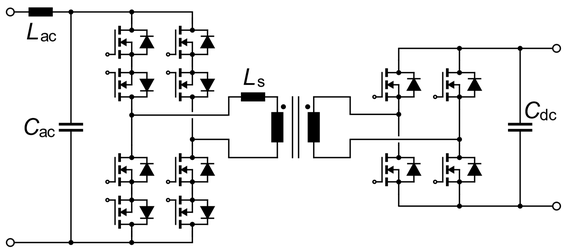
1 **Conventional dual-active bridge (DAB)**

- ► Complex control
- ► Poor wide-load performance



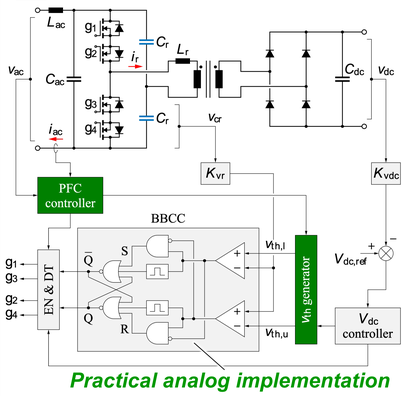
2 **Novel topology (LLC resonant)**

- ► Uses proposed control (BBCC)
- ► Potential for full soft-switching

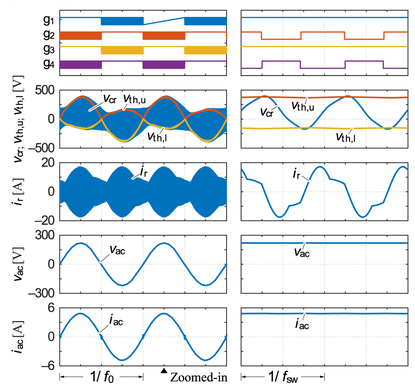


Current Progress: 500 W Prototype

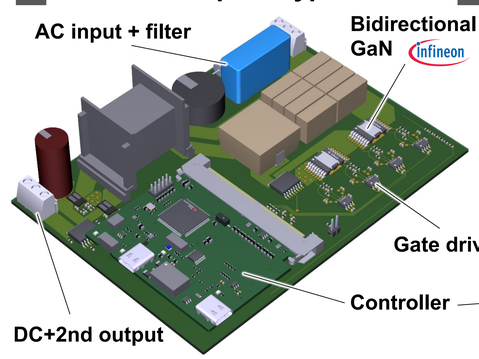
1 Bang-bang charge control



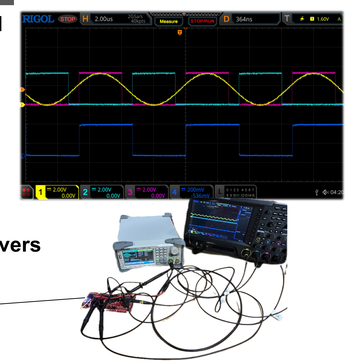
2 PLECS simulation results



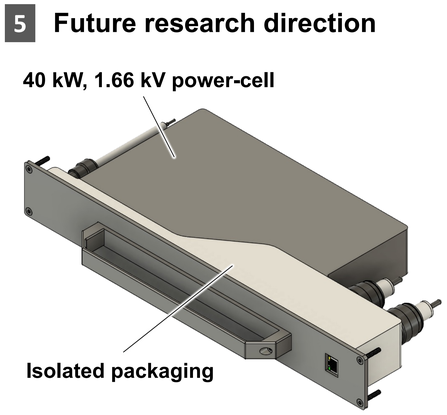
3 Verification prototype

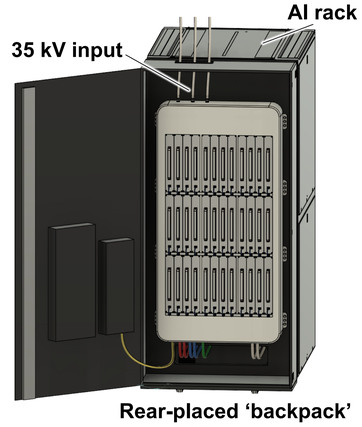


4 Real-time BBCC



5 Future research direction





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