All-Silicon Carbide power module based boost converter platform for grid-tied energy storage

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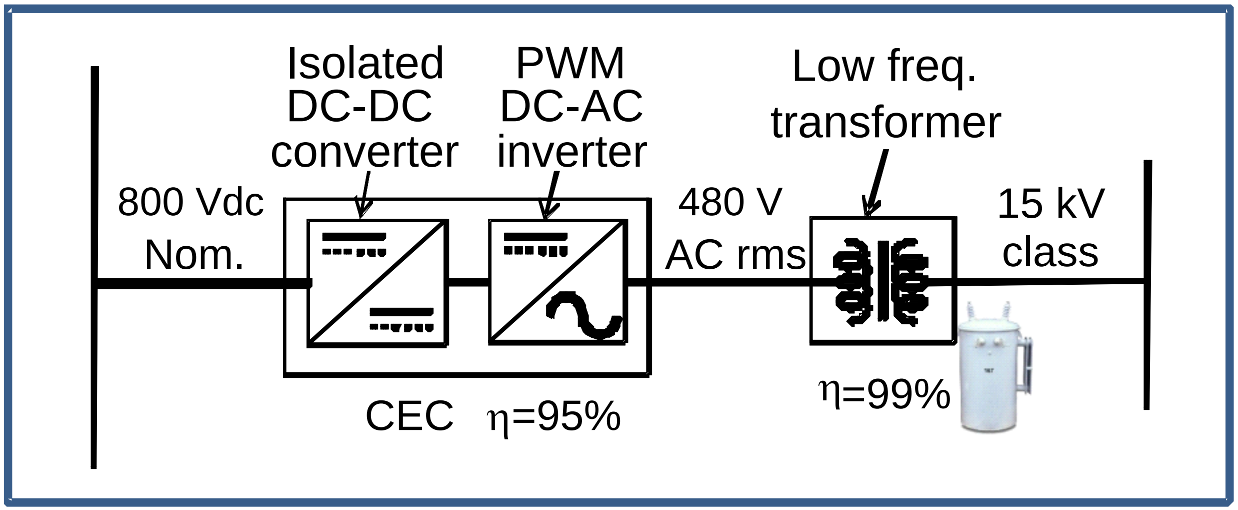
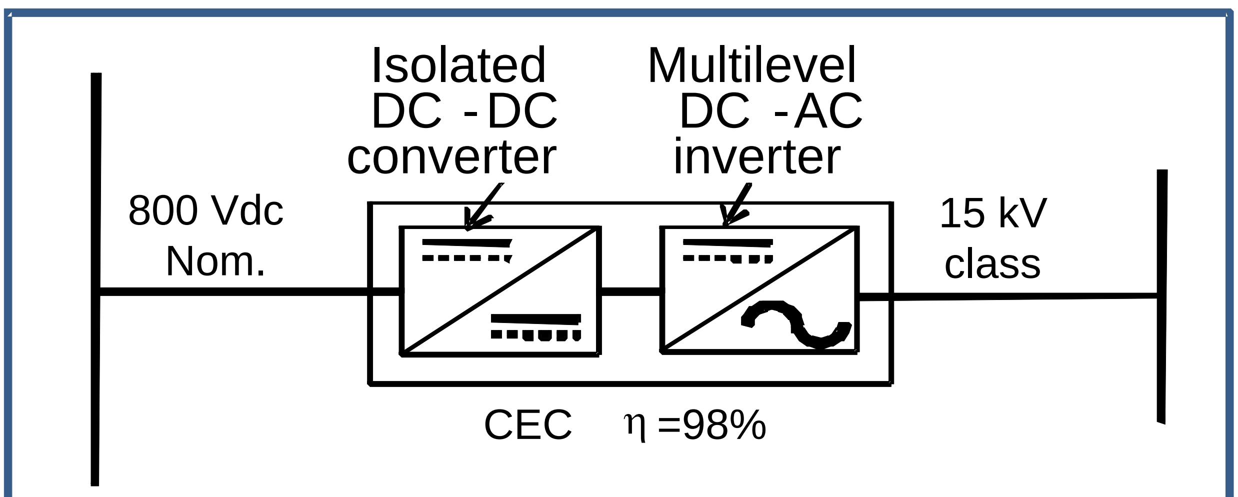
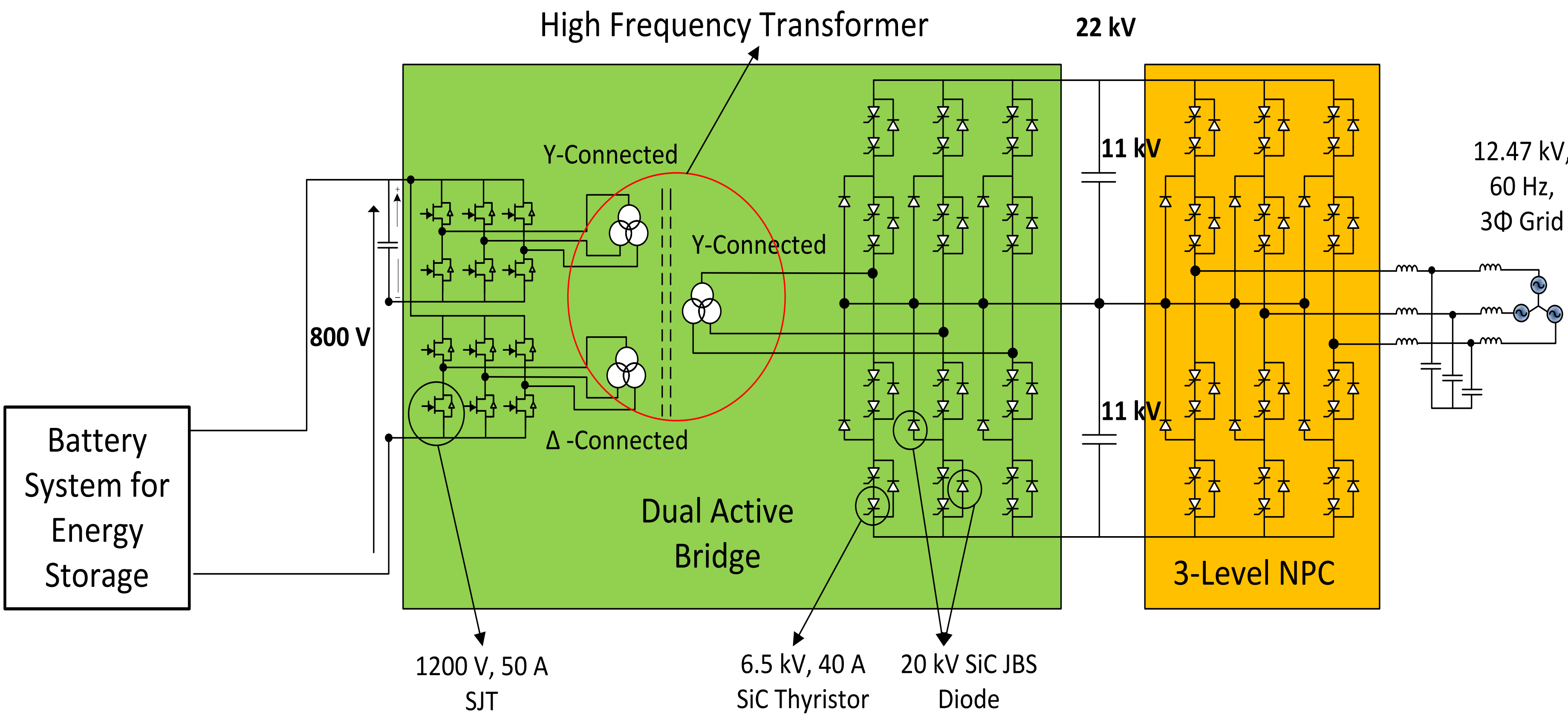
Battery Energy Storage Power Electronics Architectures



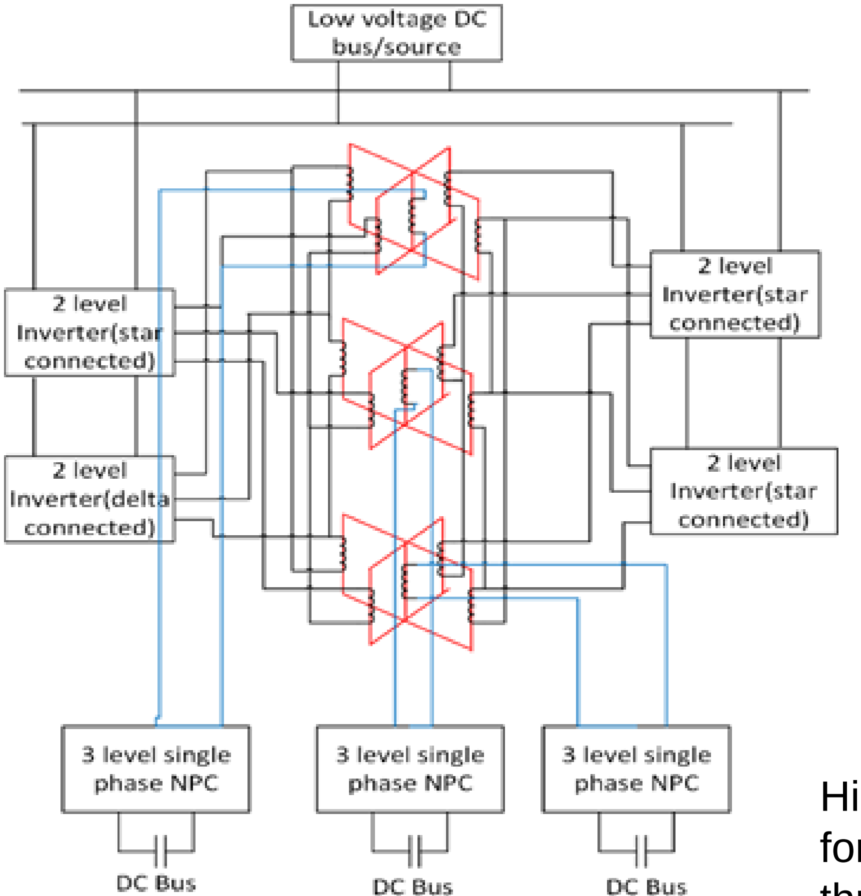


- Bidirectional, isolated DC-AC Power Conversion systems needed
- High Efficiencies are needed due to two-way power flow
- Compact systems help in wider deployments
- Low Frequency Transformer occupies space

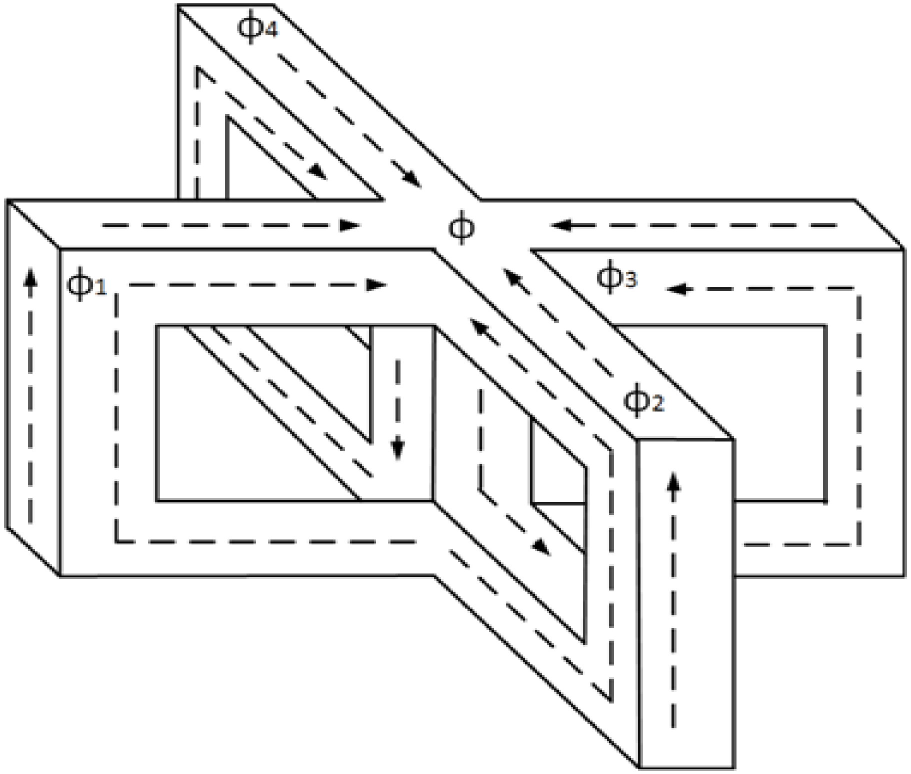
Compact, High Efficient Architecture enabled by High Voltage Devices



High Frequency 3 Phase Transformer Configuration



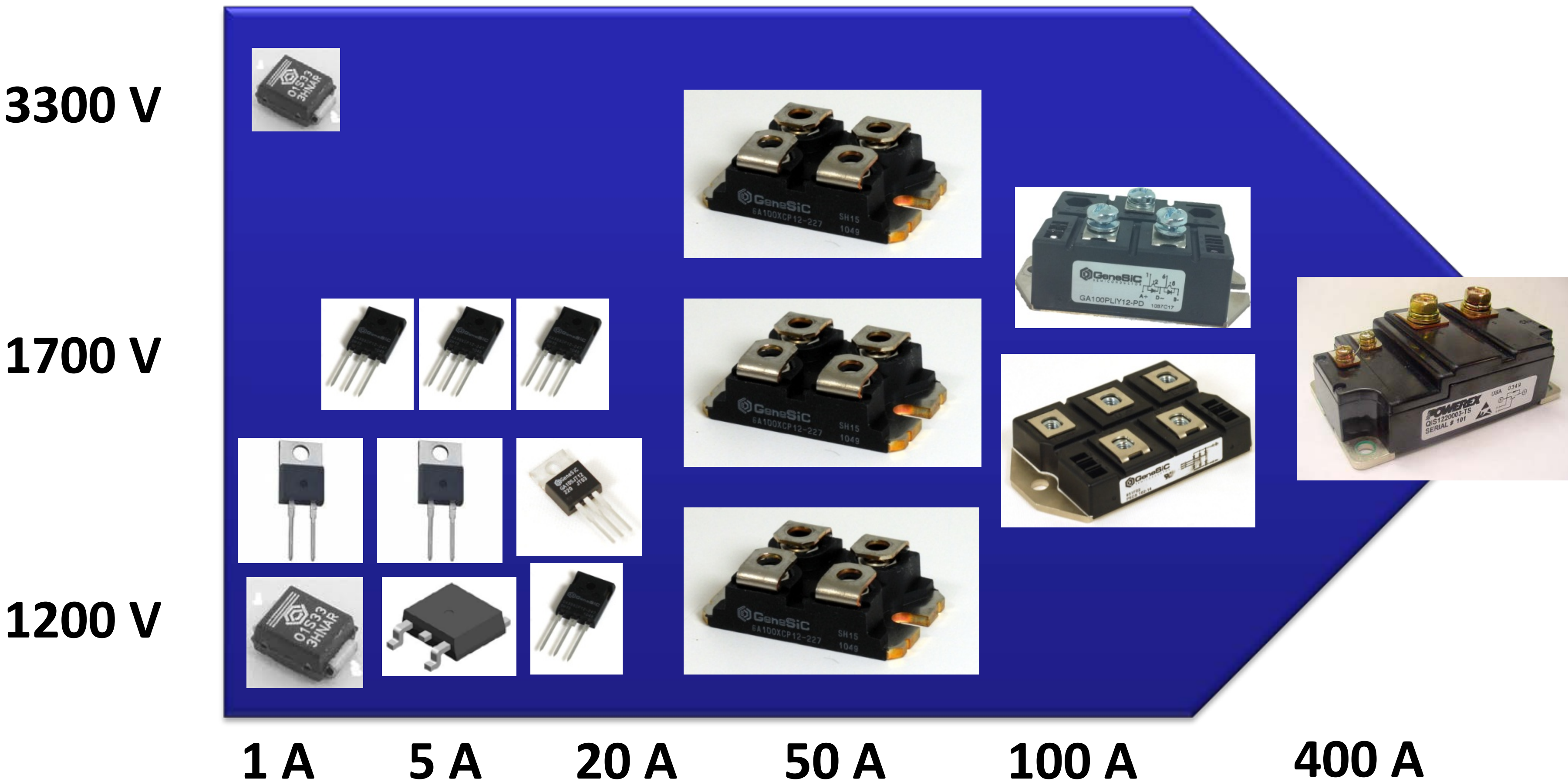
Three phase star delta DAB with higher power density



High-frequency (10 kHz) transformer configuration for the DC-DC DAB stage. The four limbs of the three transformers are connected in star and delta fashion to produce a stepped waveform at the middle limb of the transformer.

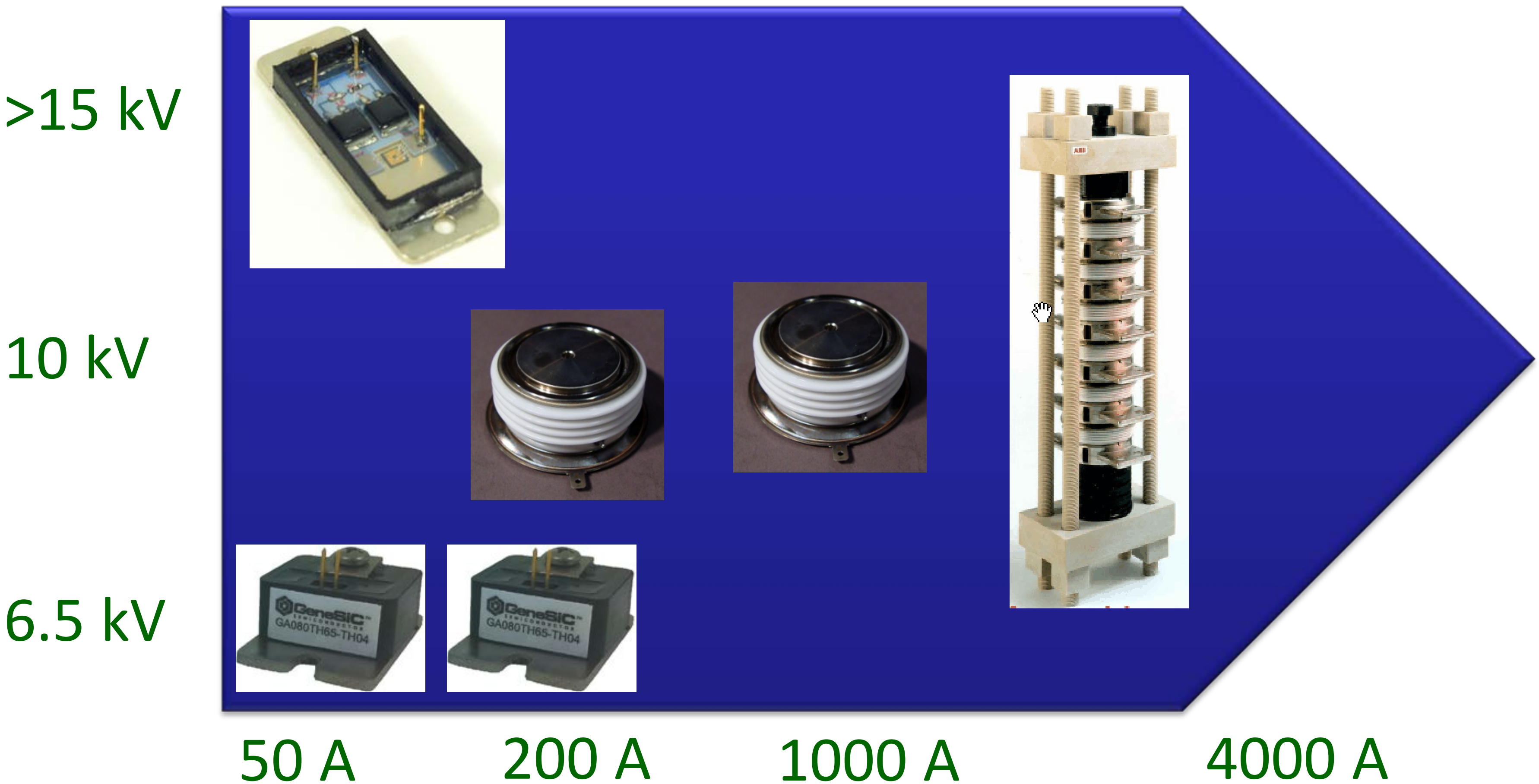
GeneSiC's Power Discrete and Module Roadmap

Transistors and Rectifiers



Ultra High Voltage devices

Thyristors and Rectifiers



Calculated Loss Comparisons at 1 MVA

Table 1: Medium Voltage/Low Current Side loss even at 1 MVA operation.

Active Power (MW)	Reactive Power (MVAR)	Loss (W)
1	0	3064
0.8	0.6	4175
0.6	0.8	5330

Table 2: Low Voltage/ High Current Side Loss

Active Power (MW)	Reactive Power (MVAR)	Loss (kW)
1	0	32
0.8	0.6	27
0.6	0.8	23

Status and Future Efforts

- Current Status
  - Project Started in July 2015
  - 6.5kV SiC Thyristors and 1200 V SJTs supplied to NCSU
  - SiC Thyristor Trigger circuits completed at NCSU/FREEDM
  - Modeling of Circuit Looses being conducted
- Future Efforts in Phase I
  - Complete SPICE Modeling of Devices to be used
  - Circuits Modeling to estimate losses and efficiency gains
  - Quantify the impact of All-SiC based power electronics on grid-tied energy storage systems

Grant Details

- Principal Investigator: Dr. Ranbir Singh and Prof. Subhashish Bhattacharya
- Program Manager: Dr. Ranbir Singh
- Grantee:

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