INTRODUCTION

▪ 10-kV SiC MOSFETs have enabled reduced stages & volume of medium voltage (MV) dc/dc converters and brought more challenges on the insulation design & parasitics control.

▪ Leakage integration in MV transformer eliminates the phase shift inductor but may introduce high loss due to leakage flux across the core lamination.

▪ Dry type insulation for MV winding brings challenges for transformer design.

MV TRANSFORMER DESIGN

▪ Thin nanocrystalline cores are stacked to form the MV transformer.

▪ Dry-type insulation for MV winding is used with 3D printed case/bobbin and silicone encapsulation.

▪ Geometry-based optimization has been adopted for transformer parameter selection.

SIMULATION AND TEST VERIFICATION

▪ Transformer leakage inductance is simulated as 62 μH, with eddy current loss ~23 W.

▪ The proposed transformer has been assembled and tested in a MV Dual-Active-Bridge (DAB) converter up to rated voltage power bidirectionally.

▪ DAB converter efficiency >99%, peak efficiency 99.3% at 40 kW.

CONCLUSION

▪ MV dc/dc transformer with stacked cores and geometry-based optimization can realize high efficiency and power density design.

▪ The analysis and test validate the transformer design with stacked transformer cores and dry type insulation.