Mechanical Characterization and Performance Optimization for GPU Fan-Sink Cooling Module Assembly

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Abstract

Three approaches for measuring clamping force, retention design optimization and thermal performance validation are proposed to optimize the a
GPU fan-sink cooling module assembly. A GPU test vehicle is designed for mechanical characterization and thermal resistance measurement by implementing three mounting mechanisms. The clamping forces are measured with various combinations of screw bolt locations and driving torques. The reference screw torque for each mounting scheme is determined from linear regression based on the recommended stress limit. Finite element analysis is used
to examine the stress distribution on the TIM. Minimizing the stress difference is
the objective. The design variables are the shape and dimension in the retention
contact spot area. An optimal retention prototype is determined from the stress
difference characteristic curve in the circular design. Thermal resistance measurement is used to validate the improvement in thermal performance. The
comparison results between the baseline and optimization show that the proposed retention design can reduce the BLT variation of the TIM to optimize
the cooling module assembly.

Keyword：GPU, fan-sink cooling module, mounting mechanism, finite element analysis, thermal resistance, TIM, retention