

Immersion Cooling Readme

Description:

This dataset includes the temperature histories captured during two-phase immersion cooling of a medium-voltage silicon carbide MOSFET. The immersion cooler is pre-filled with 10 mL of deionized water ($\sim 54\%$ of the volume of the chamber). During the thermal tests, the MOSFET is charged with a power supply (TDK-Lambda GEN300W), and the PWM fan is connected to a power supply (BK Precision 1671A) and an Arduino UNO R3 board for duty cycle control. A T-type bolt-on thermocouple (McMaster-Carr 3648K26) is mounted on a bolt connected to the base plate (T_{bolt}). Three T-type probe thermocouples (OMEGA Engineering TJ36-CPSS-032U-6) are used to measure the ambient temperature (T_{amb}) and the temperatures of the source of the MOSFET (T_{source}) and PCB (T_{PCB}), respectively. All thermocouples are connected to a National Instruments (NI) data acquisition system consisting of a cDAQ-9174 chassis and a NI 9210 DAQ card. An infrared camera (Teledyne FLIR A655c) is used to measure the temperature field on the base plate at a frame rate of 50 fps. Figure 3 shows a representative IR image captured during the tests. The maximum temperature from the IR camera is used to represent the base plate temperature (T_{bp}). To examine the effect of the PCB on IR measurement, a calibration test was performed to measure the base plate temperature with and without the PCB in between, which revealed unnoticeable differences in measured T_{bp} . A direct air-cooling test was also performed using a conventional air-cooled heat sink (Awxlumv $40 \times 40 \times 20$ mm) directly installed on the MOSFET with thermal paste (SYT 157).

Data structure:

This dataset includes five folders. Among them, the following three folders include the raw data from three representative cases.

- Immersion_cooler_50W_HFE-7100_flat: A representative test using HFE 7100 as the working fluid under a heat load of 50 W with a 100% fan duty cycle
- Immersion_cooler_50W_water_flat: A representative test using deionized water as the working fluid under a heat load of 50 W with a 100% fan duty cycle
- Immersion_cooler_100W_water_flat: A representative test using deionized water as the working fluid under a heat load of 100 W with a 100% fan duty cycle

Each of these three folders includes four files, i.e.,

1. A LabVIEW measurement file (.lvm) for temperatures of the PCB (ambient), MOSFET source, and the bolt measured using thermocouples
2. A video (.mp4) for the temperature field evolution of the two-phase immersion cooling measuring using IR imaging

3. A spreadsheet (.csv) for the maximum temperature on the base plate from the IR imaging (hotspot)
4. A MATLAB code (.m) for plotting the temperature histories during the tests.

The following two folders include maximum base plate temperatures from IR imaging for parametric study tests:

- Base_plate_temperature_from_IR_water_flat: Data from immersion cooling tests with a flat base plate under varying heat loads (10 W - 110 W) and with varying fan duty cycles (0%, 50%, 100%).
- Base_plate_temperature_from_IR_water_microchannels: Data from immersion cooling tests with a microchannel base plate under varying heat loads (10 W - 110 W) and with varying fan duty cycles (0%, 50%, 100%).

References:

Pandey, H., Du, X., Weems, E., Pierson, S., Al-Hmoud, A., Zhao, Y. and Hu, H., 2024, May. Two-phase immersion cooler for medium-voltage silicon carbide MOSFETs. In 2024 23rd IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm) (pp. 1-6). IEEE.