## Purpose

The Laird Technologies’ OptiTIM reliability test procedure has been designed to characterize the long-term performance of OptiTIM while being subjected to isothermal, thermal cycling and moderate heat - high humidity (HAST) environments.  Test Samples are placed within application-related fixtures under set conditions and at regular intervals the thermal properties of the specimens are measured.

## Test Procedure

The test setup is a rectangular metal box (14,000cc) with a QSFP-DD module in it. During the test, the module is inserted to a standard connector cage. A heat sink is assembled by a clip onto the connector cage. The heatsink pedestal protrudes through an opening in the connector cage to contact the top of the module. OptiTIM solution is pre-assembled onto the heatsink to reduce the thermal contact resistance of the interface. A single “dummy” Module was used to make all the thermal measurements. A fixed power (20 watts) from a power supply is input to the module. Thermal measurements are measured with an internal thermocouple.  Module temperatures are recorded with or without OptiTIM.  A fan (70 CFM) on the right edge of the metal box is used to for cooling.  Test values are measured in an ambient laboratory environment (22C) after the module reaches steady state. When the OptiTIM/Heatsink assembly is placed in reliability ovens, it is placed on top of a connector cage and module by the same clip used for test. Change in module temperature is reported has compared to initial metal to metal performance. Throughout the test period, the variable of interest is the thermal improvement of OptiTIM over metal-metal contact condition.  The thermal improvement is defined as the difference in module temperature with/without OptiTIM at the same power input and same fan speed.

> Reported temperatures = iModule Temp (°C) with OptiTIM interface at test condition (ex: 500 hour at 125C) – Initial Module Temp (°C) without OptiTIM interface (metal to metal contact between Heatsink and Module, MoM).

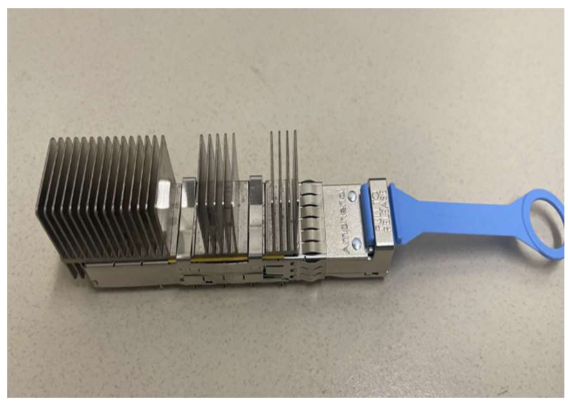
Since heat flow to the system is controlled and constant, the thermal improvement is positively related to the decrease in thermal resistance of the module-heat sink contact interface.

## Test Equipment, Test Fixture, and Sample

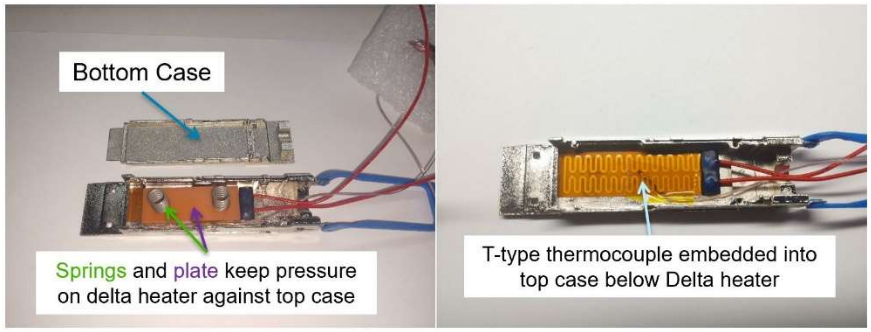
| Description | Manufacturer | Model # | Calibration Due Date |
| --- | --- | --- | --- |
| Environmental HAST Chamber | BlueM Electric | AC-7502 TDA-4 | 6/30/21 |
| Environmental Bake Chamber | Fisher Scientific | 725F | 10/31/21 |
| Thermal Cycle Chamber | ESPEC | EGNX12-7.5NWL | 6/30/21 |

OptiTIM assembled to Heatsink

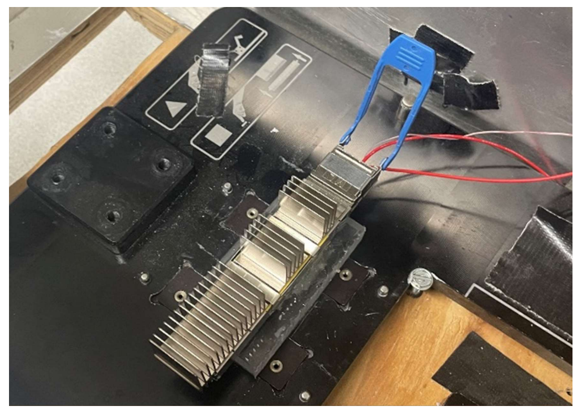
Heatsink assembled to Connector Cage
and Module



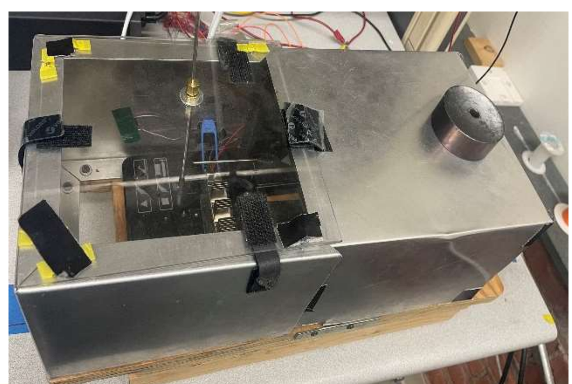
Internal "Dummy" Module design



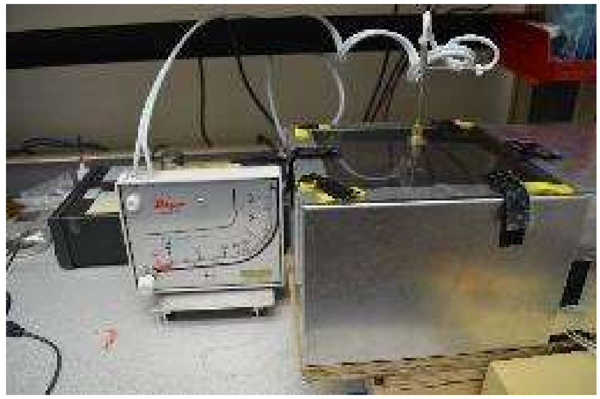

Module/Heatsink assembled in test fixture

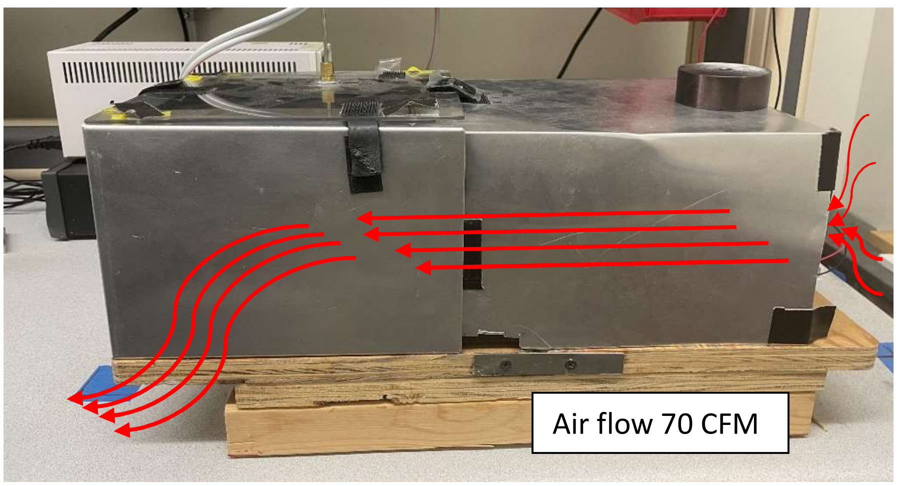


OptiTIM test fixture enclosure



OptiTIM test fixture enclosure






## Test Conditions

- Thermal shock from 125°C to -40°C (1 cycle is 30 minutes per condition, 10 second transfer)
- Isothermal @ 125°C
- Isothermal @ 150°C
- HAST @ 85°C and 85% relative humidity

## Results

### Thermal Shock

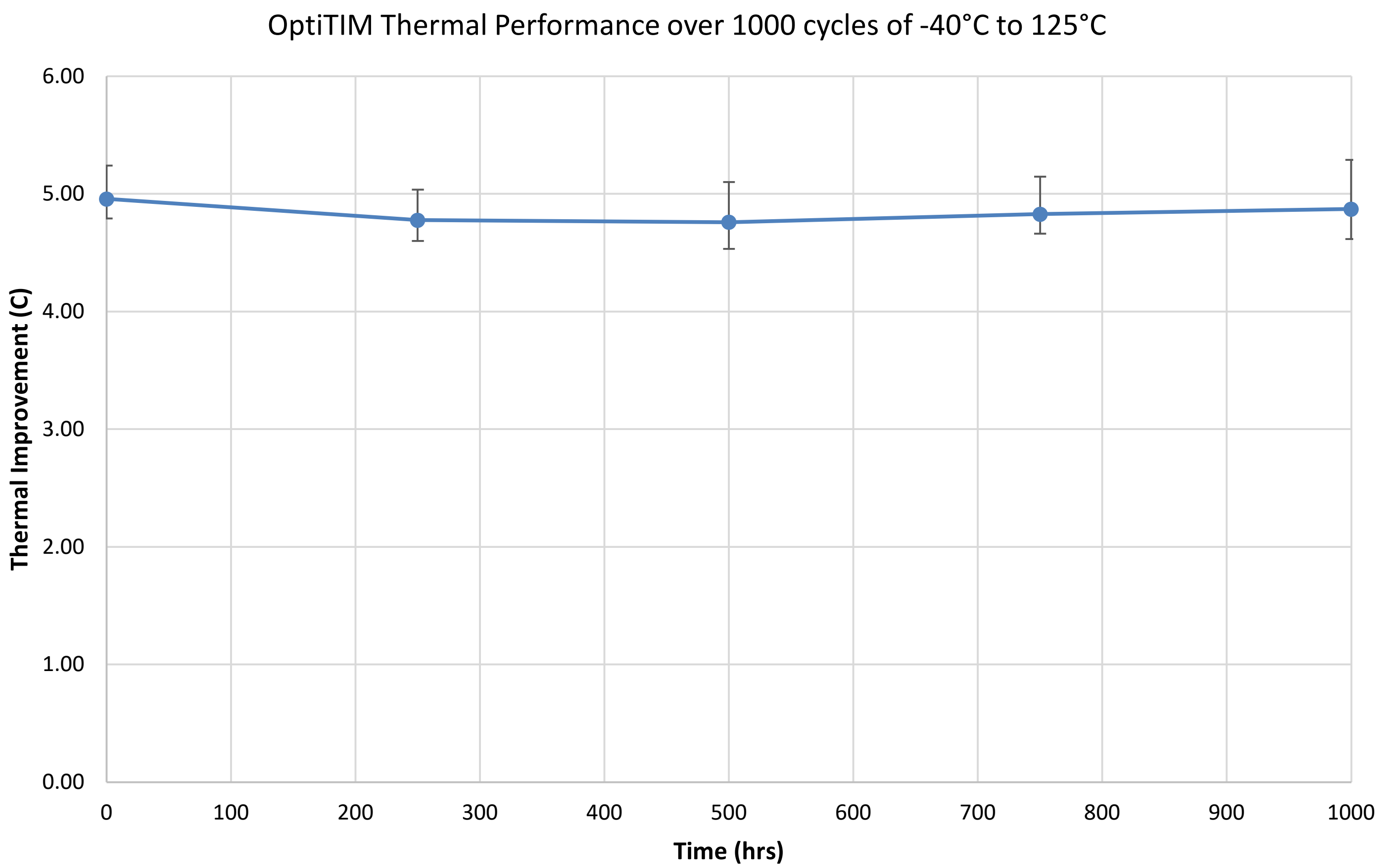



**Figure 1: Thermal Shock Results – -40°C to 125°C**
(note: one cycle is approximately one hour)

# Isothermal Bake

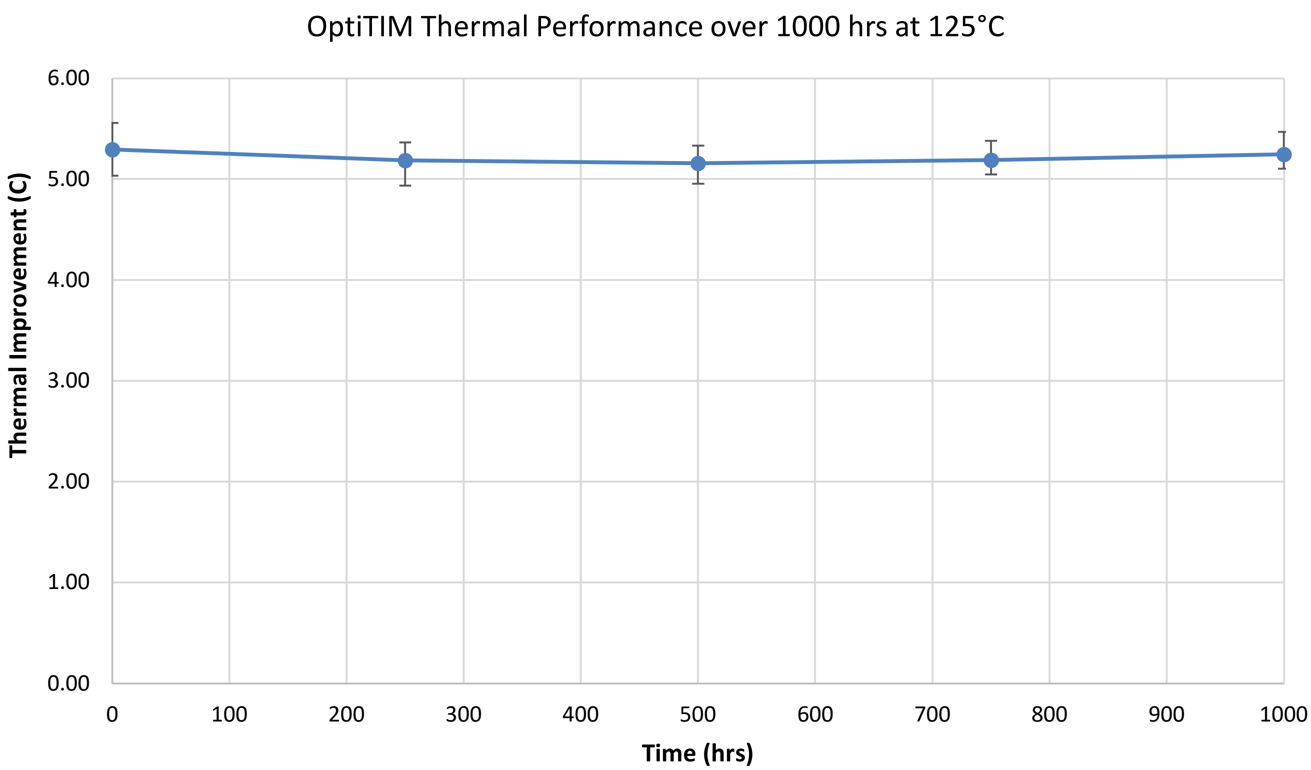



**Figure 2: Isothermal Bake Results – 125°C**

HAST

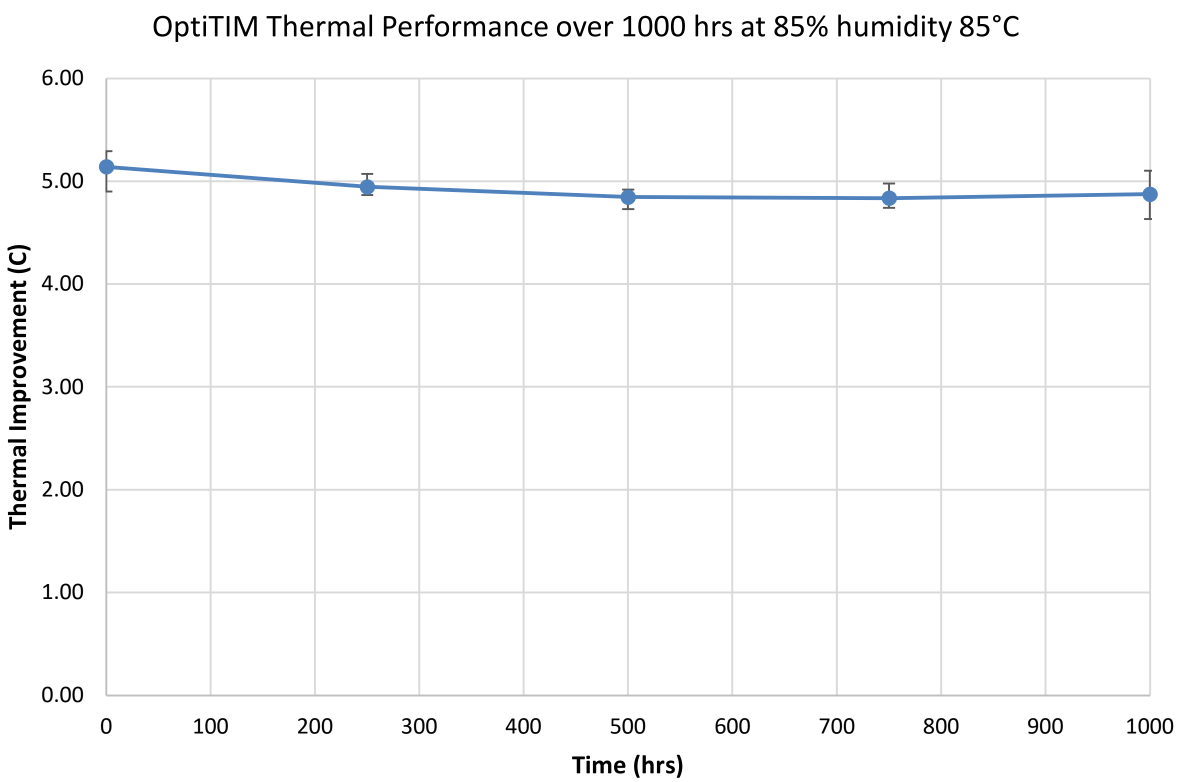



**Figure 4: HAST Results – 85°C/85%RH**

## Discussion

The data shows that OptiTIM has stable thermal performance over the three tests performed. In all cases (Thermal shock, Isothermal bake and HAST) the thermal performance maintained a < 5% change throughout the testing.