Niagara Temperature

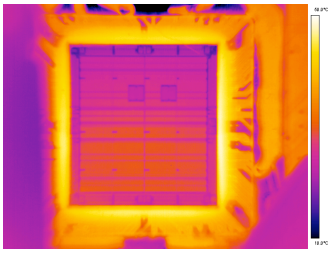
Failures and successes measuring the Sun Niagara temperature

Challenge 1: Visualizing the silicon

Objective

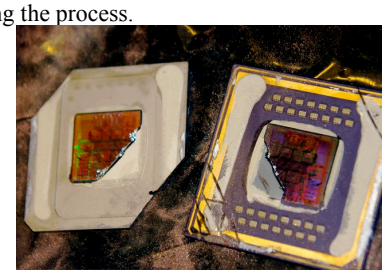
Remove the T1 metal spreader so that the infrared camera can "see" the temperature on the die.
The T1 package without the metal spreader should still be operational and placed on the motherboard.

The following picture from an Altera FPGA die shows our target. Measure the temperature of the T1 die while we can see through the silicon substrate.

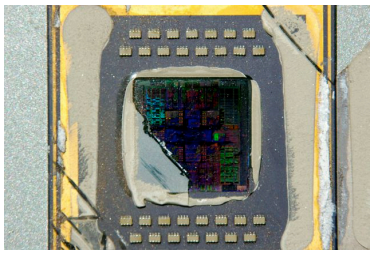


Problem

The metal spreader is glue to the die. It was difficult to remove it and we broke one of the chips during the process.



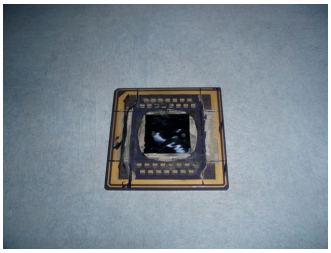
We "separated" the metal lines from the substrate (glued too hard). This is a closer look.



Solution

After trying several dissolvents unsuccessfully, we decided to "polish" the surface.

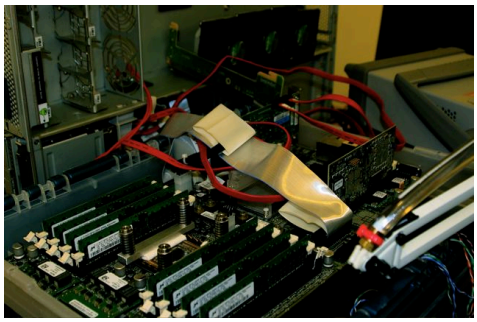
The resulting chip was operational.



Challenge 2: Remove the metal spreader and boot Solaris

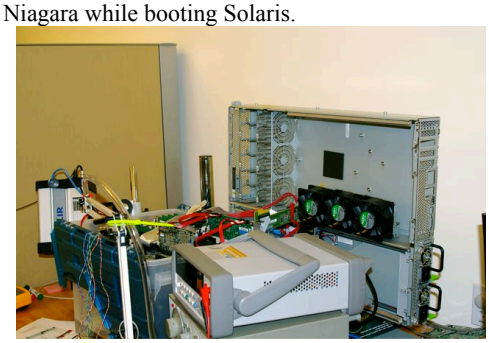
Objective

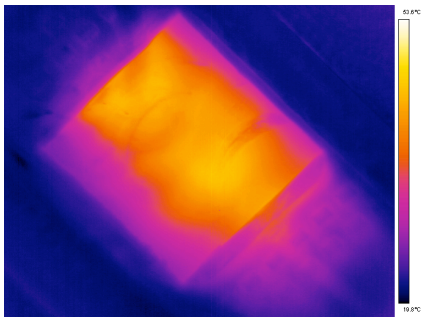
Once the metal spreader is removed, we need to place the chip on the motherboard.
The objective is to remove the metal spreader and still be able to cool down the die.
The T1 package requires pressure for the electrical contacts. To that end, we fabricated a new substitute to the heat sink to maintain the pressure while the die is visible.



Setup

The resulting setup is able to cool down the Niagara while booting Solaris.





Existing Problem (still not solved)

We are able to measure the die temperature, but not as we wanted. There are two major problems: turbulence and not transparent substrate

The turbulence problem can be solved with a sapphire layer on top of the die. This will require to fabricate another heat sink where the oil flows between the die and the sapphire window.

The major challenge is the fact that Sun chips are not transparent to IR. We measured several AMD chips and all of them were transparent. After measuring some Intel chips, we found that some are transparent (Pentium M) while others are not (Core2).

Next Steps

- Polish the Niagara substrate.
- Wait for the TSMC Niagara chips because TSMC chips are transparent to IR.