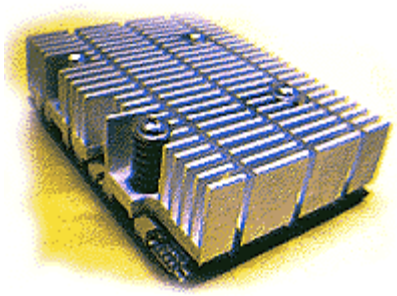
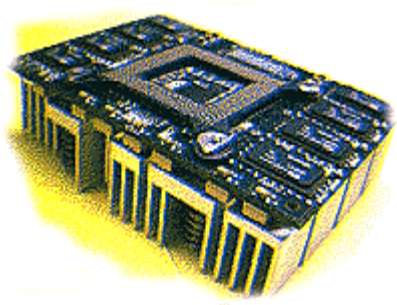
Electronic Cooling

In this application the thermal flow behavior of the Silicon Graphics Origin 2000 - MIPS R10000 Chip is investigated. An Origin 2000 CPU board consists of four R10000 chips. Each CPU chip (plus a set of L2 cache chips) is assembled into an integrated module:





Each CPU chip generates between 30 to 50 watts of power. The large heat sink connected to the CPU chip is the primary mechanism for dissipating the generated heat to the surrounding forced air.

Thermal Flow Solution

The flow-thermal behavior of the heat-sink is computed on an Origin 2000 using AcuSolve. The computational domain and problem set up are first established.

To validate the solution, the thermal flow are computed in a wind tunnel configuration and the results are compared to experiments. Confident with the solution of the wind tunnel configuration, the flow in the real configuration is solved.

The temperature distribution on the heat sink at steady state is shown below. The temperature ranges from 38 C (in blue) to 52 C (in red). Note that the minimum temperature of the heat sink is higher than the inflow air temperature of 20 C. The maximum temperature of the heat sink is 52.9 C.

Selected stream tubes of the flow about the heat sink are shown below. The stream tubes are colored by temperature in the range of 20 to 40 C. The stream-tube diameter is a measure of flow speeds. As the flow speed increases, the tube diameter reduces. Notice the strong flow recirculation behind the heat sink.

Thermal Resistance

The thermal resistance of the heat sink was computed by running the problem at several air speeds. The result is shown below: