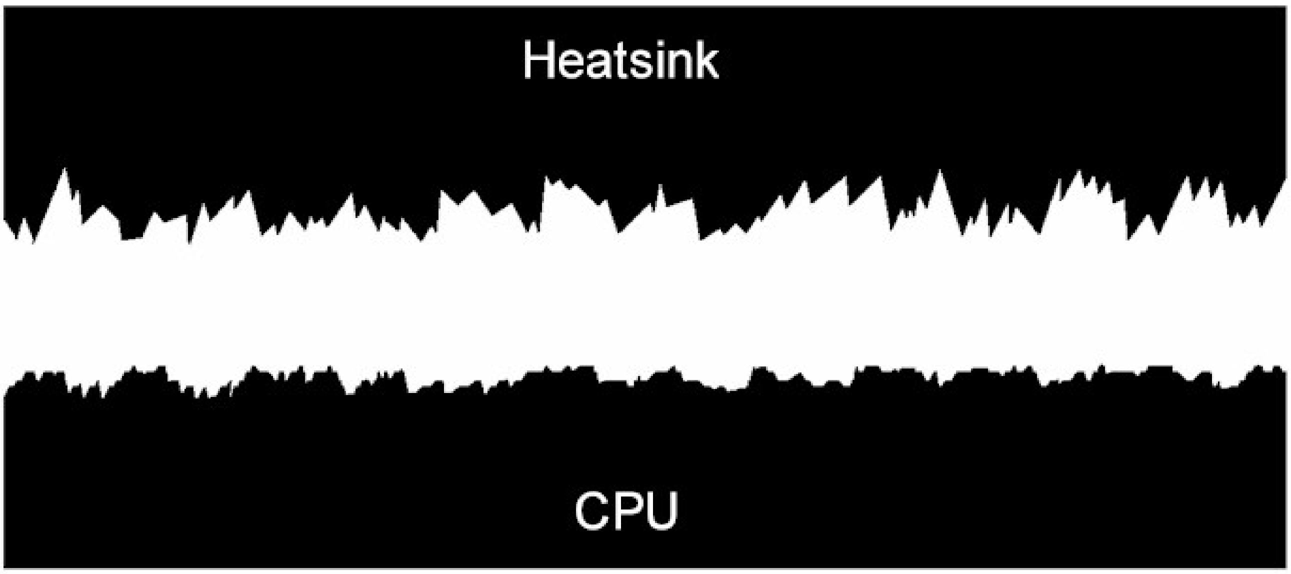
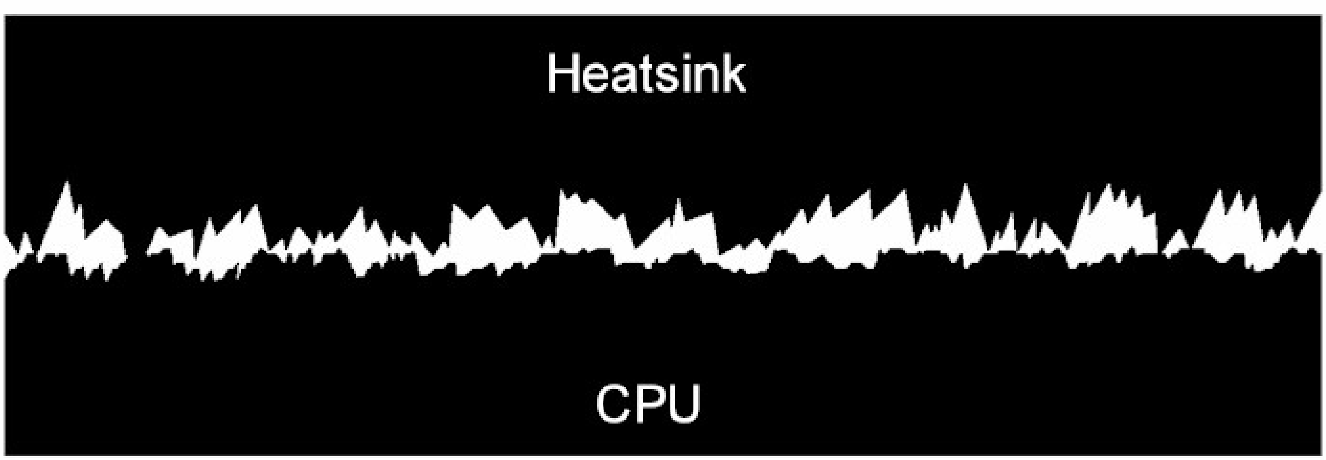
Arctic Silver®
Technical Papers and Publications

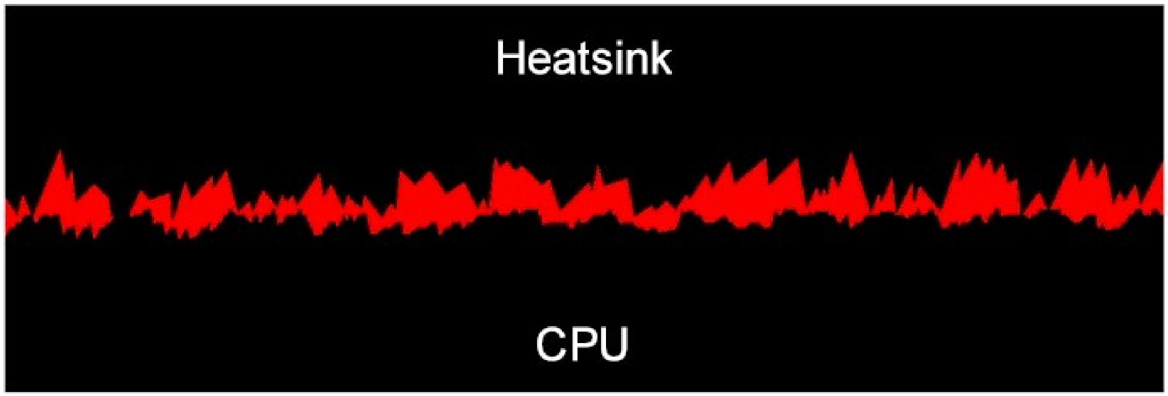
Thermal Interface Basics



While the mating surfaces on the heatsink and CPU look smooth and level to the naked eye, magnifying them several thousand times reveals the microscopic peaks and valleys that actually make up the surfaces. These microscopic peaks and valleys are shown in the illustration above.

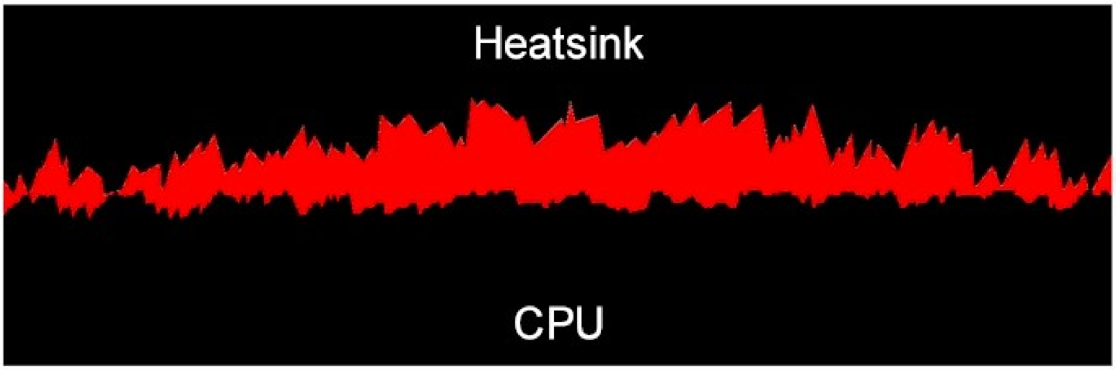


When the heatsink is put on the CPU, only the high points on the mating surfaces contact each other. On most surfaces, less than 1% of the actual surface areas make contact. All of the white space between the heatsink and CPU in the illustration above would be filled with air. Since air is an extremely poor thermal conductor, 0.026W/m°K) the high thermal resistance of the primary heat path (From the CPU to the heatsink to the air.) causes the CPU to run hot.



Thermal compounds are semi-fluidic greases that conduct heat many times more efficiently than air. The thermal compound fills in the microscopic valleys between the CPU and the heatsink as shown in the illustration above. This lowers the thermal resistance of the primary heat path and the CPU runs cooler. How much cooler depends on the thermal conductivity of the compound which can range from 0.4W/m°K to above 8.0W/m°K. The chart below shows the CPU temperature improvements offered by some popular thermal compounds on a PIII 933 at 1.85 volts and Taisol CEK 733092 heatsinks.

Measurement	Thermal Compound or PCTC*				
	None	Chromerics T725	Radio Shack	MPU 3.7 Aluminum Oxide	Arctic Silver
Calibrated CPU Internal Diode	>60 (crashed)	52	44	41	38
In-Socket Thermistor	>38 (crashed)	38	34	33	32



In addition to the microscopic peaks and valleys, many heatsinks are concave or convex. These heatsinks cause even larger gaps between the CPU and themselves and make the use of a quality heatsink compound even more important. The illustration above shows the significant space between a concave heatsink bottom and a CPU and how much thicker the thermal compound layer must be.