Heatspreader Performance Numbers – Corsair Labs Test Results

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Introduction

There's been lots of discussion recently about what type of heat spreader is best for overclocking, or if no heat spreader is best of all. We decided to run some tests ourselves, and see what kind of results we got. The objective of the tests was very simple - we wanted to see the impact of heat spreader type on the overclock-ability of a single memory module in a highly controlled environment.

Background

First, let's look at some basic theory on heat removal from integrated circuits. According to Micron Semiconductor application note TN-00-08, heat is most efficiently removed from memories via conduction (through a medium like metal, or water), rather than convection (through the air). And, heat is removed most efficiently (over 75%, according to Micron's tests) through the metal pins into the ground plane of the PCB. The secondary means of heat removal is through the back of the die into the package, and from the package into air via convection.

Once you are trying to dissipate heat into air, what matters is the surface area exposed to air. A heat spreader does just what is says, it spreads the heat over a larger surface area for more efficient dissipation. And, a heat sink takes this one step further, by adding fins and increasing the surface area that much more. That is why we see large heat sinks with fins (and sometimes fans) on high power semiconductors such as CPUs and power transistors.

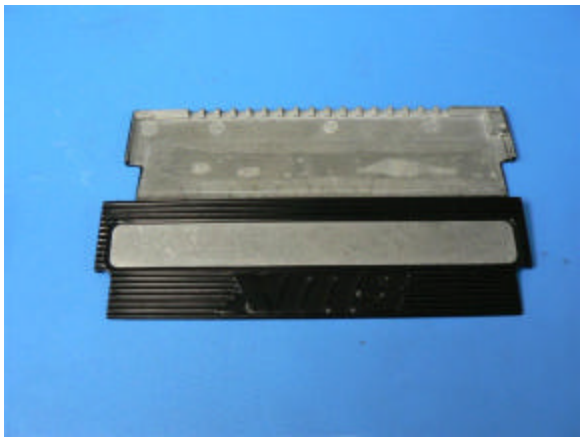
Test Setup

We decided to test the same physical memory module four times: with OCZ XTC heat spreader (referred to here on out as "Mesh" heat spreader), with standard Corsair XMS stamped aluminum heat spreader, with Corsair's "PRO" cast aluminum heat spreader, and with no heat spreader at all.

The same 512 MByte BH-5 based module was used in all tests. This module was purchased on the web. The DFI Lanparty nF4 Ultra-D (6-23 BIOS) and Athlon64 X2 3800+ (@ 1.55V, underclocked to 7x multiplier) were used as the test platform. For all tests, the memory voltage was set at 3.4 Volts, and latencies were set at 2-2-2-5-1T.

The following is a photo of the base module used.

Here is a photo of the standard and Pro Corsair heat spreaders used:



Test Procedure

Testing was very straightforward - a simple matter of determining the maximum overclock for the test platform using the four different heat spreader configurations. In order to remove as many variables from the testing as possible, the following methodology was used

All our tests used the RST Pro card “Stress Test” to heavily exercise the memory. The tests were run in one of our qualification ovens at exactly 68 degrees F ambient temperature. Our standard stability test includes 3 iterations of the RST Pro2 “Burn in” option, with Stuck, Weave, Jump, Primes, Parity, Pseudo Random, ATS, and Crosstalk turned on. A passing result was considered to be three consecutive iterations of the stress test with zero errors.

The tests were run using the same physical memory module. After each configuration was tested the heat spreader and all attachment materials were removed, and the new heat spreader type was attached using its production attachment process. Each test was run not once, but twice, to confirm results. In all cases the second test yielded exactly the same results as the first.

Test Results

The maximum overclocking results are shown in the following table:

Heat Spreader Type	Maximum Overclock
Corsair XMS PRO cast aluminum heat spreader	254 MHz
Corsair XMS stamped aluminum heat spreader	253 MHz
OCZ “XTC” mesh heat spreader	253 MHz
No heat spreader	250 MHz

As expected, all heat spreader types provided an improvement of a few MHz over the same module with no heat spreader applied. Within the heat spreader results, the XMS PRO provided a small performance gain over the XMS and Mesh heat spreaders. This is the result that we expected to see; the additional surface area provided by the larger heat spreader would naturally be expected to dissipate a nominal amount of additional heat.

The XMS and Mesh heat spreaders performed identically in our tests. We suspect that the additional surface area of the Mesh and the additional conductive surface and mass of the stamped XMS heat spreader approximately cancel each other out, and provide the same end result.

Conclusion

It was clear from the tests that the use of a heat spreader on the module increases overclockability in all cases. The XMS Pro provided the highest overclock; we believe this is due to the increased surface area provided by its increased size and ridged design. The Mesh heatspreader and the stock Corsair XMS Platinum heatspreader performed identically. One can conjecture that the additional surface area provided by the mesh approximately compensates for the reduction of the mass of the heat spreader.