phononic

TECHNICAL BRIEF

HEX 2.0 Power Consumption

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Summary

- The power draw of the thermoelectric cooling stage of the Hex 2.0 is regulated by the on-board electronics and activates the thermoelectric devices only in higher TDP conditions
- At CPU idle, the thermoelectrics are off and consume no power. At max CPU loading, the devices consume at most 35 Watts
- Testing of an overclocked Intel Core-i7 confirms the power consumption specs. An average of 6 Watts was consumed by the thermoelectric cooling stage during the test run

Introduction

Thermoelectric (TE) devices are semiconductor-based coolers. In other words, a current/voltage supplied to the TE devices creates a temperature gradient and turns the device into an active heat pump. When designing a TE-enhanced CPU cooler, a major point of optimization is effectively harnessing the TE devices with as low power consumption as possible. The Hex 2.0's Active-Passive design and on-board control electronics combine with Phononic's high efficiency TE devices to maximize CPU cooling effectiveness, yet minimize average power draw. We performed extensive performance testing at a range of CPU loads to determine the best TE power settings and turn-on setpoints.

At low TDP (i.e. low CPU load) conditions, the control electronics and temperature sensors recognize that the CPU temperature is low and the TE devices do not activate. So, the only Hex 2.0 component consuming power in this condition is the fan, just like a normal, air-cooled heatsink.

Under mid-level CPU loads (50-120 Watts) the Hex 2.0's TE cooling stage activates in "low cooling" mode and consumes 12 Watts. At maximum CPU loads (>120 Watts), the TEs turn to "high power" mode, and the electronic controls limit the power draw to no more than 35W.

Testing

So, what does this mean in normal PC operation? We tested the Hex 2.0 mounted to an Intel Core-i7 5960X, which we overclocked to 3.7GHz. To simulate low CPU loading conditions, we played 1080p YouTube videos in Chrome. For higher CPU loads, we used PassMark Performance Test and Aida 64's CPU or FPU stress tests. The CPU usage was monitored and plotted vs time in Aida 64. The power consumption of the Hex 2.0 was monitored and recorded using the Hex 2.0 Dashboard App for Windows.

Figure 1 shows CPU load (in Watts) as a function of time. The colored regions of the plot correspond to the power supplied to the Hex 2.0's TE cooling stage. As described above, under typical, low CPU usage conditions such as web browsing and watching web videos, the TE cooling stage is not activated on the Hex 2.0. Under mid-range CPU loads (60-120 Watts), the TEs either cycled between low cooling and off or stayed in the low cooling setting, consuming 12 Watts at most. Under the highest load condition, FPU stress in Aida64 (140+ Watts CPU load), the TEs consumed 35W. Once the stress test was turned off, the Hex 2.0 quickly turned the TE cooling stage off and TE power consumption returned to 0 Watts. For this test, the average power consumption of the TE cooling stage was roughly 6.1 Watts.

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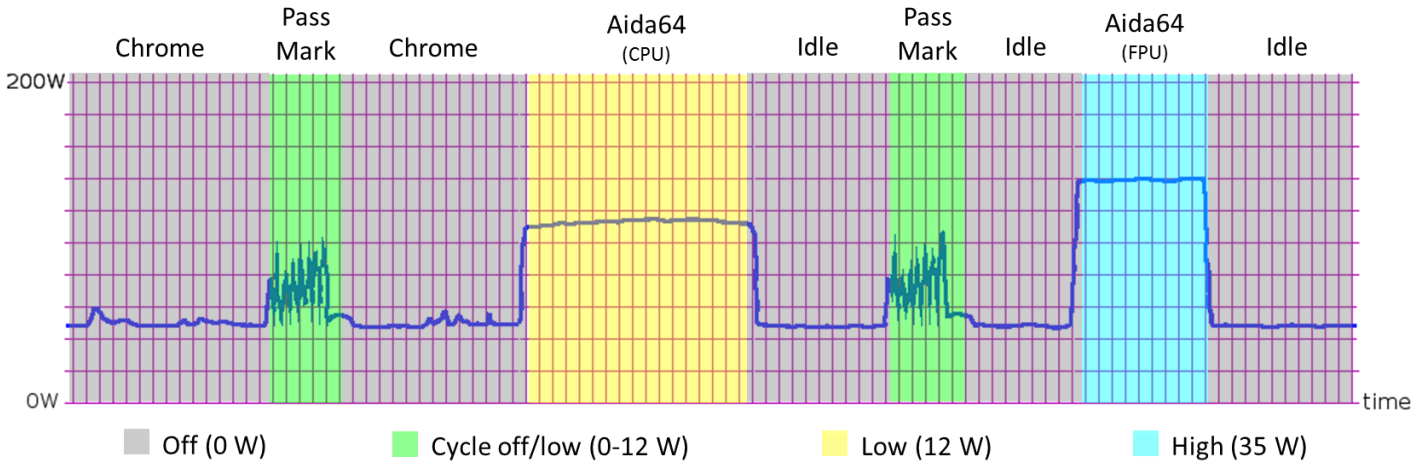

Figure 1. Aida64 plot of CPU load (in Watts) vs time for an Intel Core-i7 5960X (overclocked to 3.7GHz) cooled by the Hex 2.0. The shaded regions on the plot show the power draw of the Hex 2.0 TE cooling stage during different CPU load states.

Conclusion

As you can see, the Hex 2.0 has been engineered and tested to get the cooling performance benefit of the TE devices only when needed most – during high CPU load conditions. The controls, devices and active-passive thermal design maximize performance, minimize power draw and have the added benefit of avoiding the risk of condensation associated with conventional, "always-on" Peltier coolers. This allows the Hex 2.0 to deliver liquid-cooling performance with minimum added power draw and without water.

Of course, your PC configuration may yield slightly different results and depends on CPU TDP, general usage, as well as case airflow and ambient temperature. That's why we want to hear from you! With the Hex 2.0's upgradeable firmware, we will be publishing new firmware and updates to the Hex 2.0 dashboard app, so your feedback is important to creating additional performance tweaks. We invite you to contact us through customer care to provide feedback on your specific builds. You can check for firmware and software updates from the HEX 2.0 Dashboard – and you never know, we might add a cooling profile or make changes based on your feedback.