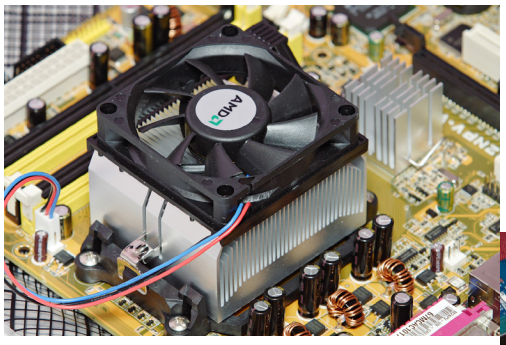
BLINN.COMmunications
1 November 2021
179 Caren Avenue • Worthington • Ohio 43085-2520 • 718.577.1054 (NYC) • 614.785.9359 (Ohio)

Heat Is Your Computer's Most Insidious Enemy

Dropping a computer into a lake, off a balcony, or under a truck is a quick way to ruin a it. There are slower methods, but they are equally harmful.

One of the most destructive forces any electronic device can encounter is heat. The hottest component in nearly any computer is the central processing unit (CPU). Desktop computers typically have heat sinks and fans that sit on top of the CPU. Notebook computers, tablets, and other portable devices rarely couple fans with the CPU, but some of them have fans designed to pull air through the case.



Desktop computers (above) often have large heat sinks with fins on the CPU and a fan above the heat sink.

Notebook computers (right) may have a small fan and an even smaller heat sink, but sometimes no fan at all

My primary computer, a notebook that's attached to external drives, monitors, a keyboard, a mouse, optical drives, and a USB sound system that I use to record TechByter Worldwide podcasts, provided an excellent reminder about this starting in late July.

The computer began shutting down abruptly. There was no blue screen. There were no error messages or warnings. The computer just shut off. I should have realized immediately that this was a textbook case of overheating, but I didn't. Then I spent nearly two months looking for the cause, thinking I'd found it, making changes to address the issue, and then finding that it wasn't solved.

Notebook computers and tablets have more problems with heat than do desktop systems. A desktop computer is a relatively large box that has a lot of air around the components.

Because there's a lot of space in a tower case, the CPU will almost always be fitted with both a heat sink and a fan. Combined with a fan in the power supply, these cooling devices perform well to maintain workable temperatures.

Notebook computers are designed to be fast, small, and light because that's what consumers want. The trouble with this approach is that faster CPUs run hotter, components are packed together with little breathing room in smaller cases, and often there's no way to fit a fan on top of a CPU.

Designers depend on complicated heat sinks, louvers for ventilation, and small fans. My computer, for example, has small exhaust air louvers with fans on the back and large inlet louvers on the bottom. One of the louvers on the bottom is partially blocked by the manufacturer's docking station, and I've run the computer sitting on the desk for four years. Clearance under the computer is little more than one-eighth of an inch. Additionally, I've run the computer with the case closed.

Despite an impressive heat sink that stretches from the CPU to metal hinges that are exposed even when the cover is closed, the computer seemed to be fighting a losing battle with heat.

Approaching Shutdown

The CPU is designed to shut down if the CPU's maximum temperature is exceeded. This is intended to protect the CPU from damage.

CPUs specifications list a thermal-junction maximum (TJ_{max}). This is the temperature, expressed in degrees Celsius, at which the central processing unit will throttle back performance or simply shut down. The maximum for most CPUs is 100°C.

Any computer that consistently runs at or above 80°C is in danger, and my computer's temperature monitoring application revealed that the CPU routinely ran at that temperature and sometimes exceeded 97°C. Suddenly, the cause of the crashes was obvious.

Once I figured out what the problem really was, I needed to find a way to pull more heat away from the CPU.

I had wasted a lot of time identifying the problem because the computer hadn't had an overheating problem for four years. Why did this problem not occur sooner? Manufacturers apply what's called *thermal paste* between the CPU and the heat sink. The thermal paste transfers heat efficiently to the sink, but it can dry out and lose efficiency.

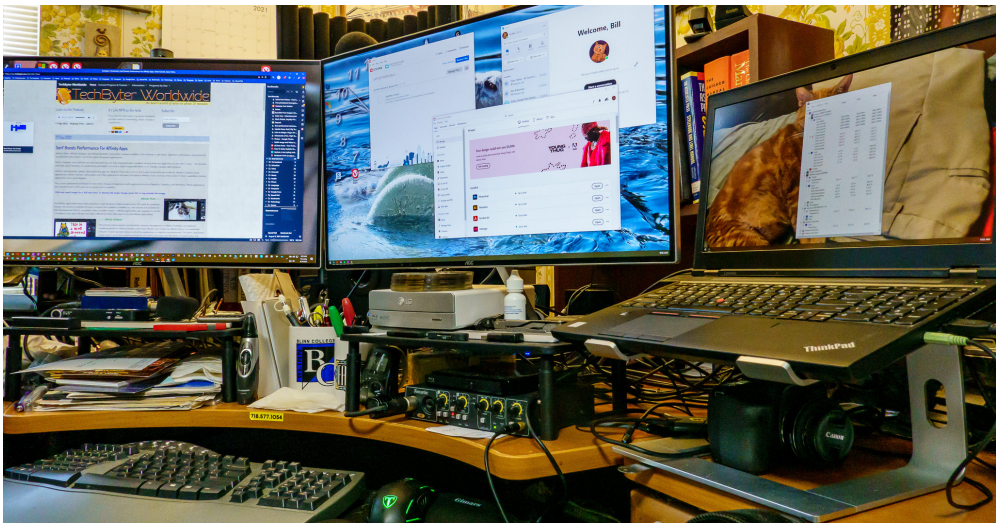
Blinn Communications News (ISSN 2639-5762) is for clients and friends of William Blinn Communications, Worthington, Ohio. Phone 614.785.9359 (Columbus) and 718.577.1054 (NYC). On the Web at www.blinn.com.

Fixing the Problem

THREE OPTIONS EXIST ON A DESKTOP COMPUTER, BUT ONLY TWO CAN BE REASONABLY CONSIDERED FOR NOTEBOOK COMPUTERS.

One possible option would have been to disassemble the computer, remove the old thermal paste, apply new thermal paste, and reassemble the computer. This is a relatively straightforward operation with a desktop system, but a complex and tedious operation with a notebook computer, so I put it at the bottom of the list.

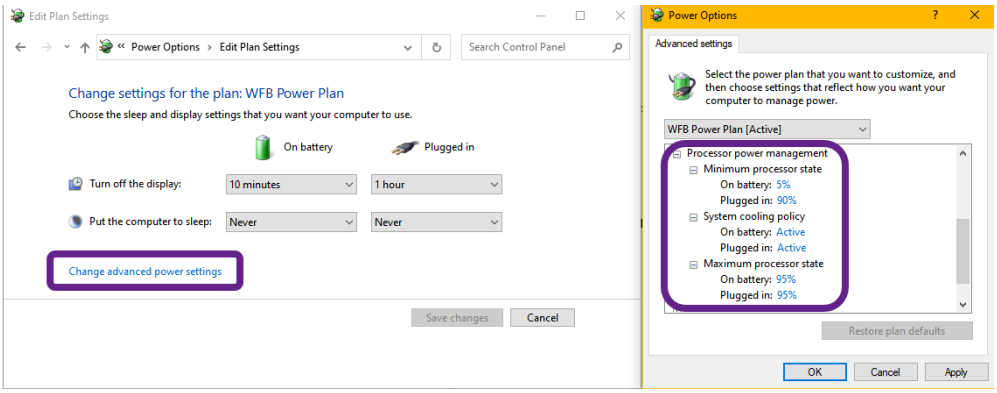
Running the computer with the case open was clearly the easiest way to provide more ways for heat to escape. It also provided a third screen that I could use for processes that I didn't want on either the primary or secondary screen. Opening the case helped a bit, but not enough to keep the CPU out of danger.



RUNNING WITH THE COMPUTER OPEN AND PLACING IT ON A STAND PROVIDED IMPROVED CIRCULATION AND AN ADDITIONAL VIEWABLE SCREEN.

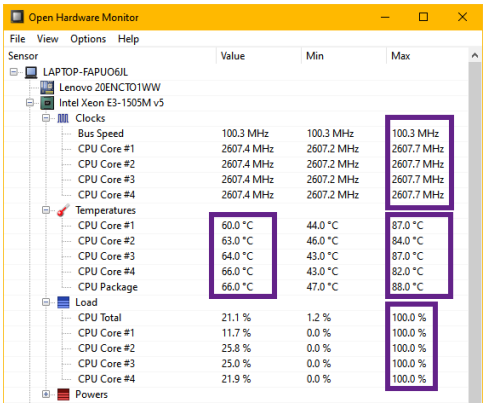
To provide better circulation around the case, I purchased a heavy-duty aluminum laptop stand that moved the computer up about five inches. That lowered operating temperatures. Although normal operating temperatures were lower, the CPU still came too close to 100°C during operations that needed a lot of processing power.

Windows can set minimum and maximum CPU power settings and specify whether to use active or passive cooling. These settings require drilling down through several layers of menus. Each of the three items has two sub options if the computer has a battery, one for when it's plugged in and another for when the battery is being used. Except for the minimum power setting, the values will probably be the same.



ADVANCED POWER PLAN SETTINGS ARE ACCESSIBLE ONLY VIA THE CONTROL PANEL'S POWER SECTION.

- **Maximum processor state:** Both plugged in and on battery settings will probably be 100%. This would seem to be the most crucial setting, so I changed both battery and plugged in values to 95%. That helped, but the temperature readings were still higher than I wanted them to be. I didn't want to dial the overall performance back any further.
- **System cooling policy:** This should never be set to passive because that disables fans. Microsoft has more information about this on the *website*.
- **Minimum processor state:** This setting seems counterintuitive. The value will be low for battery operation, 5% on my computer. The plugged-in value was 100%, so thinking that this might affect the computer's operation when the CPU was approaching 100°C, I tried changing the plugged-in value to 75%.



IMPROVED CIRCULATION AND MINOR POWER PLAN CHANGES REDUCED MAXIMUM TEMPERATURES FROM THE HIGH 90S TO THE MID 80S, EVEN WHEN THE CPU IS RUNNING AT 100% CAPACITY.

These changes made significant differences. Maximum temperatures remained below 80°C and standard operating temperatures were around 55°C, well within the comfort range.

Eventually I moved the minimum power state up to 90%. Temperatures continued to be acceptable, and the crashes have been eliminated.

Had I ignored the problem or simply decided to live with the frequent crashes, excessive heat would have eventually destroyed the computer's CPU. Now the computer should provide at least another year or two of reliable service.

The temperature of the computer's CPU is something that users should check regularly to head off a problem before it starts causing system crashes and before high temperatures damage or destroy the CPU. Ω