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Snapdragon X Series Offers Leadership Efficiency and Thermals for Windows Laptops

Ryan Shrout
Matthew Connatser

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Qualcomm

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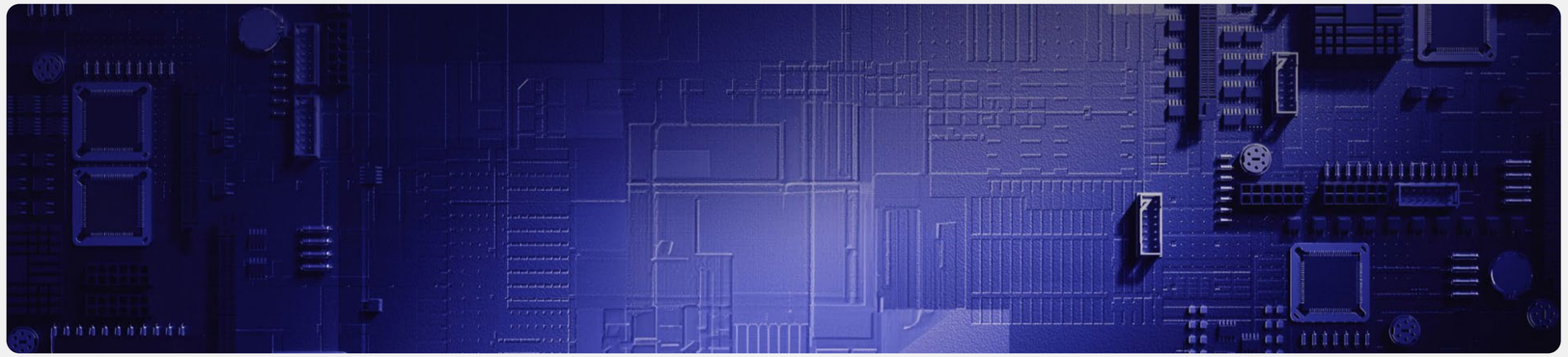
Importance of Silicon Efficiency



The processor used inside a computer, whether it's a desktop, laptop, or some other kind of device, has many important attributes; performance, power consumption, and thermals are easily the top three. But these characteristics are all dependent on one even greater, and maybe underappreciated aspect: power efficiency. The simple balance of how much power yields how much performance is crucial for any chip.

When you think about efficiency, you might only really connect it to power consumption. However, a processor that has low power consumption might not be very efficient, and a very efficient chip may consume quite a lot of power. Power efficiency is the end result of how a processor is engineered, the combined outcome of the architecture, the manufacturing node, and even secondary aspects like power delivery design. Efficiency is more than just battery life, and silicon capability is more than just performance.

More power efficiency can enable greater performance without an increase in power consumption, which also limits the increase in thermal output. Similarly, increased power efficiency can also be used to keep performance at the same level, but with lower power usage and consequently cooler temperatures. Reducing power and thermals can even create a slight positive feedback loop, as processors become less efficient the hotter they run. So, a reduction in power consumption would lead to a reduction in heat, and that could push the baseline efficiency just a little higher.

It's obvious why improved efficiency leading to greater performance is a good thing, but the benefits on the power side of the equation are substantial as well. Battery life is determined by power draw and battery size, but since the battery size on most portable devices can't be increased, power consumption becomes the crucial factor. More power efficiency means more battery life, or potentially better performance without compromising battery life.

The Importance of Silicon Efficiency

Heat is also an important consideration, as processors can only get so hot before malfunctioning, and users might prefer especially low temperatures for a better device experience. Device size can also be influenced by how much heat a chip produces, because that heat needs to be funneled through a cooling system, sometimes requiring fans, and then all of these components need to fit inside a chassis that's able to dissipate enough heat to keep things cool.

Consumers usually won't accept a cooling solution that only barely prevents a processor from thermal throttling. Loud fans, hot-to-the-touch chassis, and weight are other important factors that are inherently linked to heat. A processor that outputs a high amount of heat is going to result in tough decisions being made in regards to a device's design.

Heat however becomes much less of a problem when power efficiency is optimal. Choosing a chip with greater power efficiency and the right power level makes it far easier to design a device with fewer drawbacks, compromises, and quirks. By contrast, using a processor that has relatively poor power efficiency can cause a cascade of issues and result in a device with suboptimal performance, high temperatures, loud fan noise, low battery life, and potentially even more issues.

Thermals and Real World Experience Testing

While real-world experience often means performance, application experience, and usage comparisons, it can also mean looking at system behaviors that many customers might not think of when considering a purchase. At Signal65 we believe in testing real world experience, and of course that includes benchmarks and performance but also the hands-on experience of using a device; comparing devices and implementations on areas you might not consider at first is key to getting a full view of how a device will be received in the market.

Although thermal performance is certainly an important factor in performance and battery life, it's also very relevant to comfort and quality of life. Weight is not obviously connected to heat, but one of the heaviest components in a computer (particularly laptops) is the heatsink, which is usually composed of aluminum or copper fins tightly packed together. The bigger a heatsink is, the more heat it can dissipate out of a processor, but this means increasing the weight of a device.

Most coolers are also equipped with fans, which are the primary source of noise on laptops. How loud a fan can be depends on lots of factors: the build quality of the fan, how many fans in total there are, the size of the heatsink, how hot the processor is allowed to get, and of course the amount of heat entering the heatsink. It's never fun to have a noisy computer, which is an annoyance at best. It's especially bad for a computer to be loud when it really needs to be quiet; if you ever find yourself needing to use your PC in the same room that someone's sleeping in for instance, you definitely don't want it to be loud.

The heat itself can also cause problems for the user experience. Even once it's been dissipated, heat has to go somewhere; if it's through a vent and into the open air, that's usually not a problem, but heat will also radiate throughout a device's chassis. Device designers may even intentionally divert heat into the chassis in order to improve cooling potential, especially for smartphones (which obviously don't have fans and vents) and smaller laptops that have limited room for larger heatsinks. But since processors can easily hit 90 degrees Celsius, devices can get uncomfortably hot very quickly. Users understandably don't want their devices to get hot in the areas that they're touching. For laptops in particular, there are a few crucial areas that should be at most warm: the keyboard, touchpad, and bottom of the machine.

Measuring Processor Efficiency

For today's testing, we wanted to look at the efficiency of competing silicon solutions in the PC space and compare some modern thin and light laptops across a connected set of tests: sustained performance in multi-threaded workloads, thermal design of the systems, and chassis temperatures in these extreme conditions. In particular, we are looking at the balance between thermals of laptops and performance of those laptops. The outcomes of these tests should help tell us which modern laptop processors are more efficient and how much that difference can translate into observable and tangible benefits to consumers.

Test Setup

ACER Swift 14 AI

Dell XPS 13

ASUS Vivobook

For this test, we're comparing the Snapdragon X Elite to competing Intel Core Ultra 200V (Lunar Lake) and AMD Ryzen AI 300 (Strix Point) processors, so it was imperative to find laptops that were similar except for the actual silicon. This isn't always easy; there can be subtle or dramatic differences between laptops that might look the same on the outside. And unfortunately, laptop manufacturers infrequently offer two models of a laptop where the only difference is the processor(s) inside. But thankfully, companies like Dell, Asus, and Acer now offer Snapdragon X Elite-powered laptops in their mainstream product stacks, with minimal differences other than the chip itself.

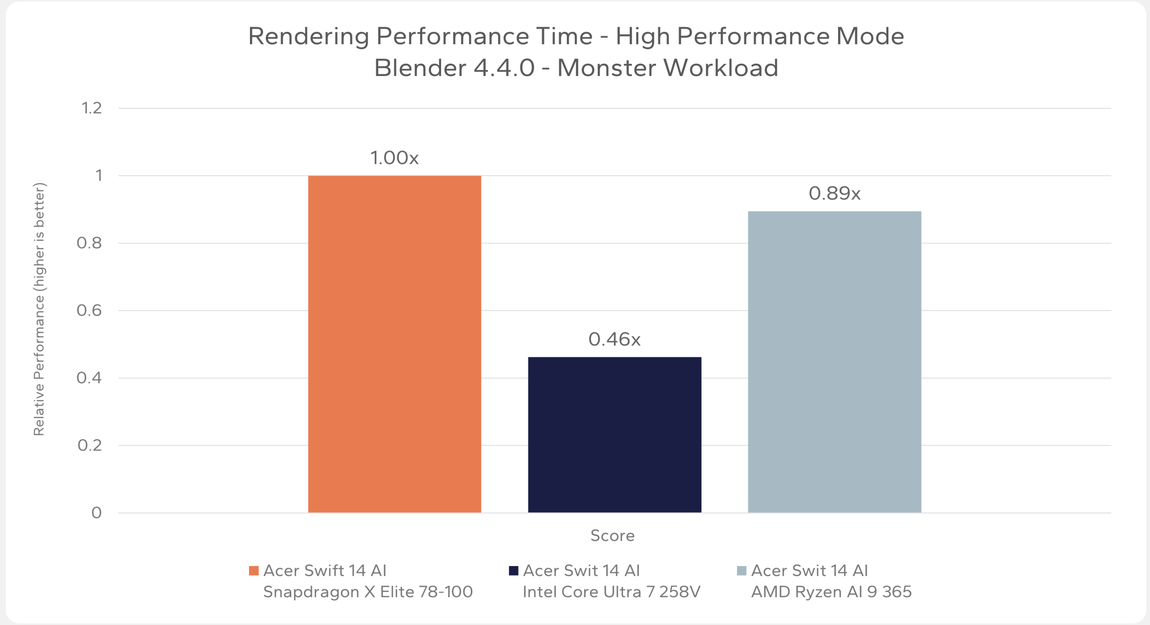
For our testing process, we used a FLIR C5 camera to measure temperature and hot spots on the top keyboard/trackpad (C panel) area of the laptop, as well as the bottom (D panel). These look at infrared light rather than visible light, using an IR sensor and a traditional camera sensor, overlaying the heat data on a diluted standard image, so you can see where hot and cool spots on anything reside.

In our testing for this report, we ran our laptops in an office environment with a consistent ambient temperature. Obviously, it's paramount to control for this variable because the impact can impact the data.

We used a Blender workload to represent a saturated compute state but also a loop of the Procyon AI computer vision test to showcase the thermal state of even a more efficient block of IP, the NPU. As AI becomes more relevant, the efficiency and thermal performance of NPUs will matter more for the user experience.

Results: Acer Swift 14 with Blender 4.4.0

The Acer Swift 14 created maybe the most unique comparison in our analysis as it allows us to look across a set of three different processors, all using basically identical chassis, cooling, and design. Our testing looks at the Snapdragon X Elite 78-100, the Intel Core Ultra 7 258V, and the AMD Ryzen AI 9 365. For this testing we are again utilizing the Blender 3D rendering application and the “Monster” workload.

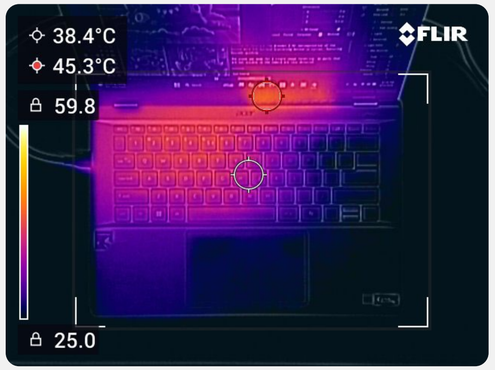


The Snapdragon X Elite platform again holds the outright lead in performance, this time against both the Intel ‘Lunar Lake’ design (by more than double!) and the AMD Ryzen AI chip (by about 11%). It’s another impressive victory of the X Elite part, showing that it can both provide the efficiency needed for long battery life and cooler thermals against the Intel offering, and exceed the multi-threaded performance capabilities of the AMD Ryzen.

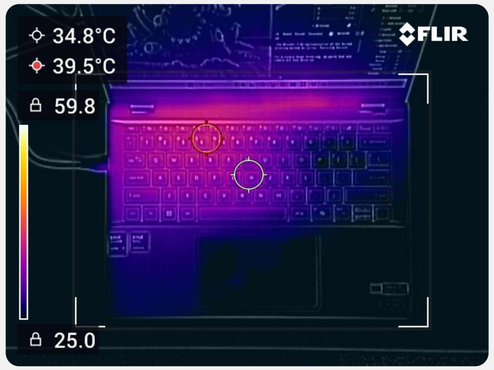
Of course, the bigger question is thermals and how hot these laptops get.

SNAPDRAGON X SERIES OFFERS LEADERSHIP EFFICIENCY AND THERMALS FOR WINDOWS LAPTOPS

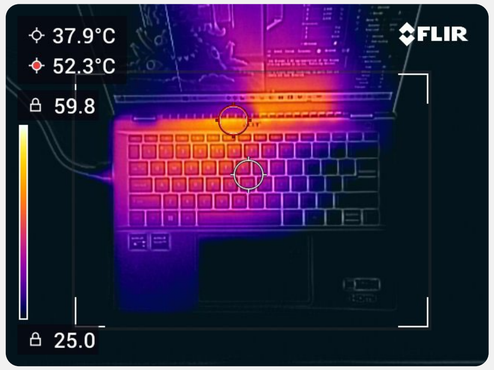
Results: Acer Swift 14 with Blender 4.4.0



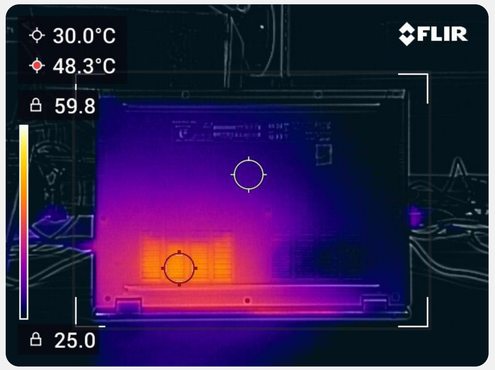
Swift 14 AI with Snapdragon X Elite, C Panel



Swift 14 AI with Intel Core Ultra 200V, C Panel

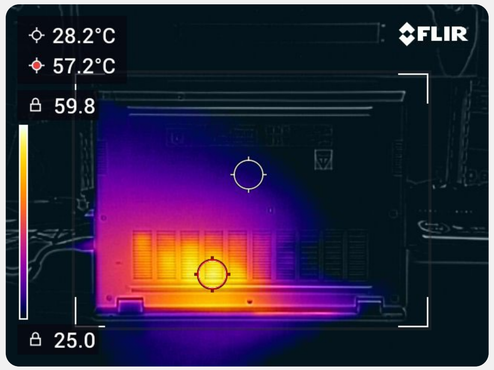


Swift 14 AI with Ryzen AI 300, C Panel



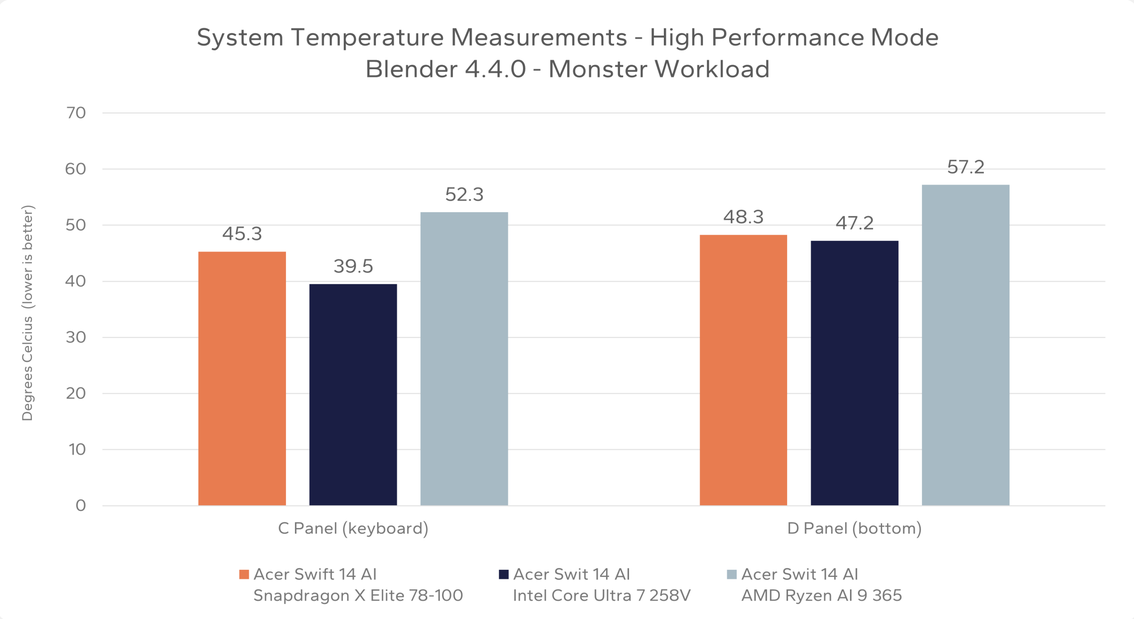
Swift 14 AI with Snapdragon X Elite, D Panel

Swift 14 AI with Intel Core Ultra 200V, D Panel



Swift 14 AI with Ryzen AI 300, D Panel

Results: Acer Swift 14 with Blender 4.4.0



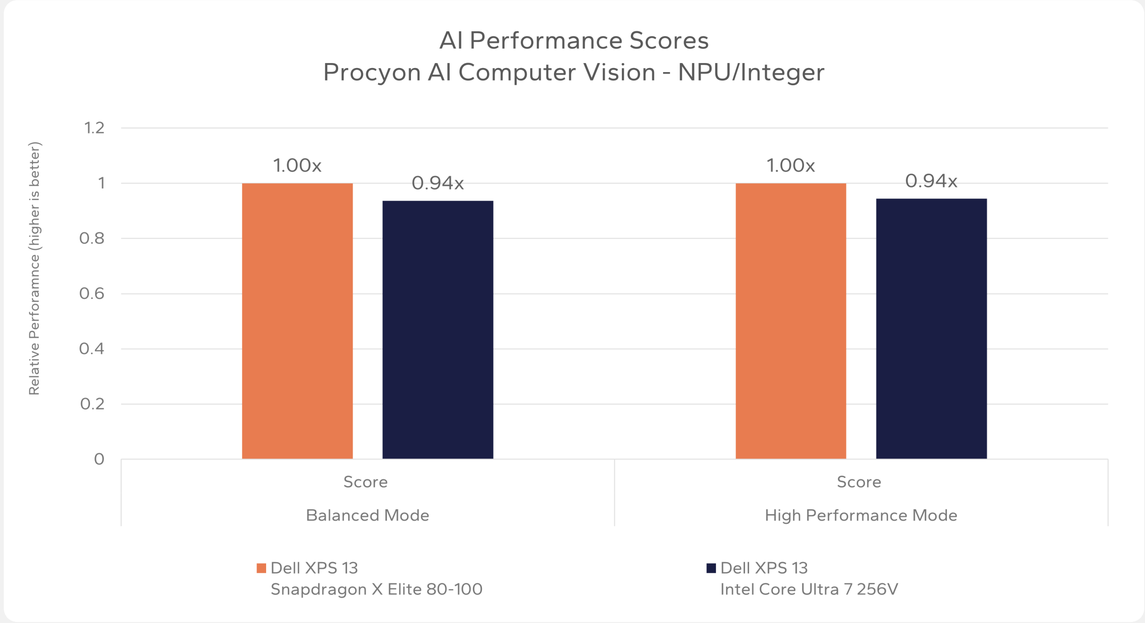
It's clear from this data that the AMD-based Acer Swift 14 is the hottest of the three designs, nearly 9C warmer than the Snapdragon offering on the bottom of the system during our Blender workload and 7C warmer on the keyboard area. Those are HUGE gaps that will absolutely result in unpleasant experiences for consumers heavily utilizing their machines on their legs. This result isn't that unsurprising since the Ryzen AI 9 365 is more for higher performance mainstream laptops, but the performance side of the equation doesn't really work out since the Snapdragon X Elite is a decent bit faster.

The Intel-based Acer laptop does do very well here, running more than 5C cooler on the C panel than the Snapdragon device and basically even with the X Elite when comparing the temperatures on the bottom (D panel). But when you consider that the Snapdragon CPU is able to offer more than TWICE the performance in this workload than the Intel CPU, you can see how these tradeoffs need to be considered closely when making purchasing decisions. Running cooler is obviously good for the Lunar Lake model, but it's probably not enough to justify having less than half the performance.

Results: Dell XPS 13 with Procyon AI

The Dell XPS 13 is a great notebook that combines a thin and light design, with unique attributes like its edgeless trackpad and keyboard implementation. Our testing is comparing two versions of the machine, one powered by the Intel Core Ultra 256V 'Lunar Lake' design and the other with the Snapdragon X Elite X1E-80-100. These two models have the same dimensions and weight, and on the inside there's few if any differences besides for the processor itself, making the comparison about as perfect as can be.

Let's start by looking at the performance of each system while running the popular Procyon AI Computer Vision test, pushing the performance and capabilities of these AI PCs and their integrated NPUs. In both Balanced and High Performance mode, the Snapdragon-based Dell XPS 13 machine performs 6% better than the Intel Core Ultra 256V version, indicating better AI throughput.



Of course, what we're really interested in is how hot these two laptops get, which is more or less the name of the game since performance is very similar between the Lunar Lake and Snapdragon X Elite chips.

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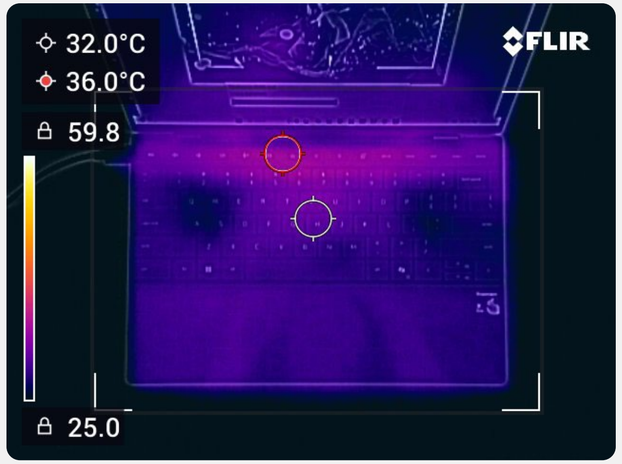
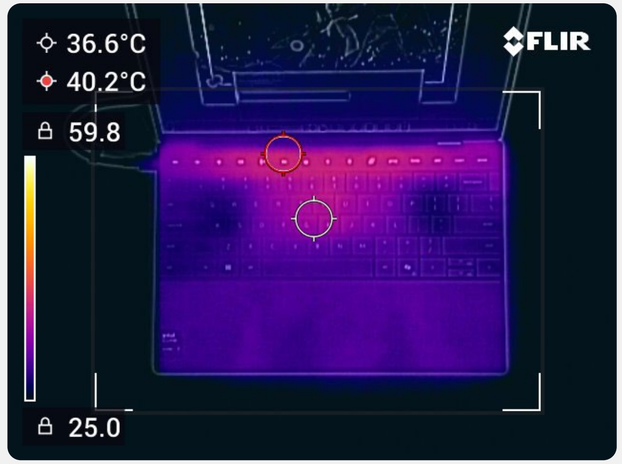
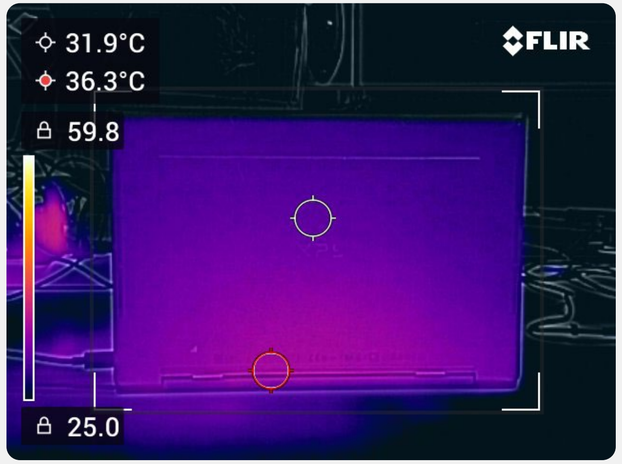
Results: Dell XPS 13 with Procyon AI



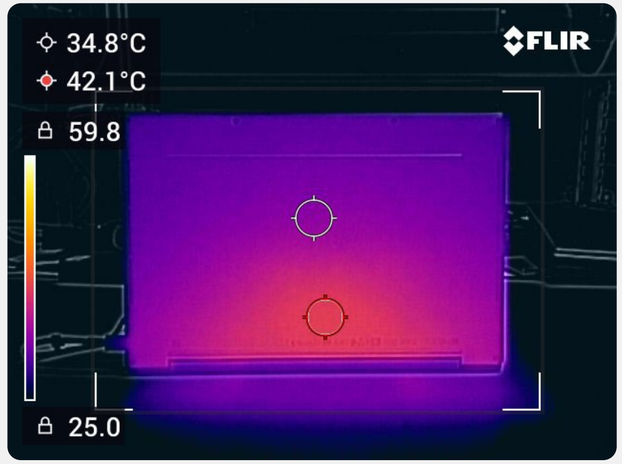
XPS 13 with Snapdragon X Elite, C Panel



XPS 13 with Intel Core Ultra 200V, C Panel.

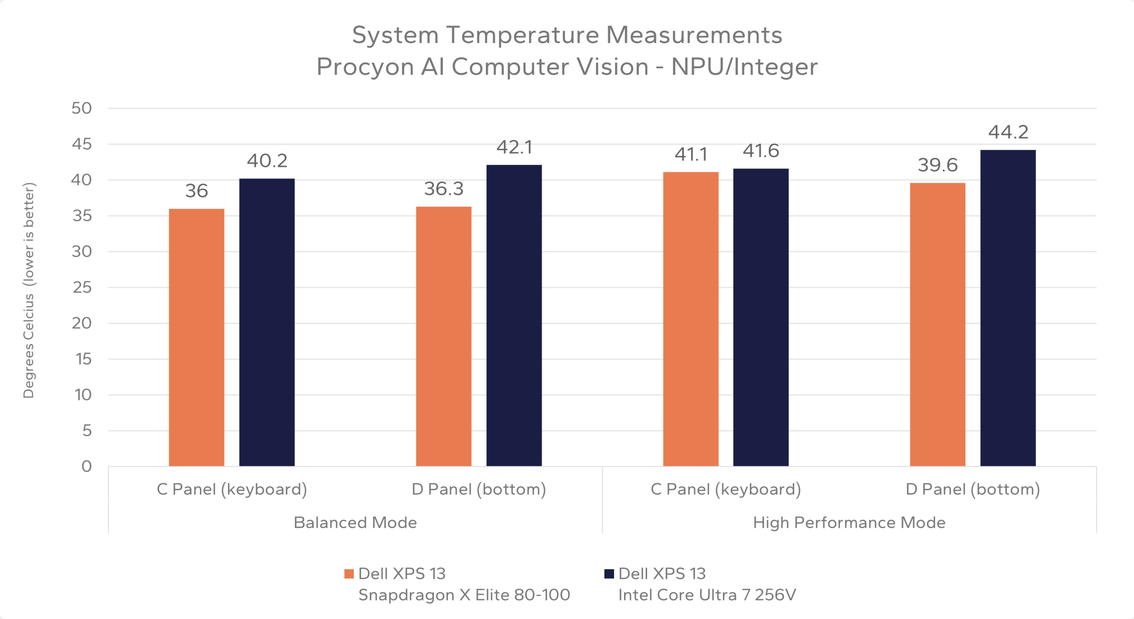


XPS 13 with Snapdragon X Elite, D Panel



XPS 13 with Intel Core Ultra 200V, D Panel.

Results: Dell XPS 13 with Procyon AI



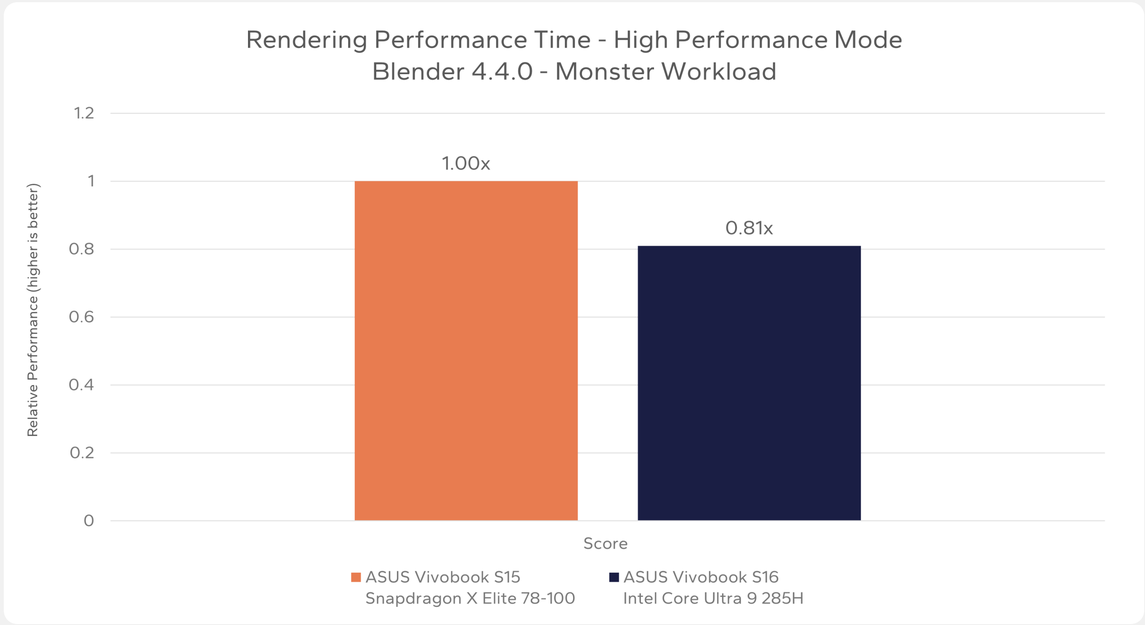
After looping the AI performance test for 10 minutes, both systems warm up, but the Dell XPS 13 with the Intel processor is up to 5.8C hotter than the Snapdragon system, as measured on the bottom (D panel) in Balanced performance mode. And while both machines get equally warm on the keyboard (C panel) in High Performance mode, the Core Ultra system is 4.6C warmer on the D panel measurement. Running five degrees hotter is a significant difference considering the cooling solution and chassis are about identical for both laptops. It also indicates that the Lunar Lake model is consuming more power while also performing slightly below the Snapdragon X Elite version, a sign that Intel's NPU is less power efficient than Qualcomm's by a notable margin.

It's worth keeping in mind that today, an NPU doesn't see nearly as much usage as the CPU cores, and for certain users even the integrated graphics might get more of a workout. However, AI is becoming more commonly used in everyday apps, and for long periods of time. For instance, background blurring for video calls can lean heavily on an NPU, such as in Microsoft Studio Effects, and video calls tend to go on for at least a few minutes, which is more than enough time for an NPU to heat up. It seems likely that in the future, NPUs might be doing stuff all the time just like a CPU, whether it's in the foreground or the background.

Results: ASUS Vivobook with Blender 4.4.0

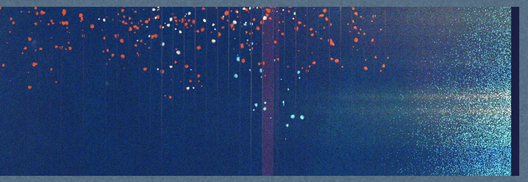
Our ASUS Vivobook systems are not exactly an iso-chassis comparison, but they are similar in design and build quality, and definitely target the same audience and segment of the market, even though the Intel-based system has a 16” screen vs the Qualcomm-based design with a 15” screen. By measuring only OEM-to-OEM, we can reasonably ensure that the same design methodology and strategy is used across the devices.

Our testing compares two versions, one powered by the Intel Core Ultra 9 285H (Arrow Lake-H) and one with the Snapdragon X Elite X1E-78-100. These two CPUs could be considered to address different market segments, but looking at the performance results indicates that the Snapdragon CPU is more than holding its own! For this benchmark we are utilizing the Blender 3D rendering application and the “Monster” workload often used for testing and measuring CPU performance.

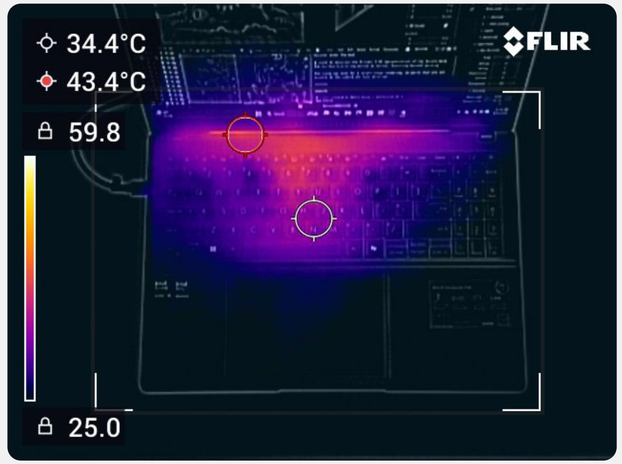


The Snapdragon X Elite 78-100 is over 20% faster than the Intel Core Ultra 9 285H, despite the Snapdragon chip being targeted at thin and light designs. It’s an impressive result that continues to showcase the power of the multi-core design that Qualcomm has built.

Results: ASUS Vivobook with Blender 4.4.0

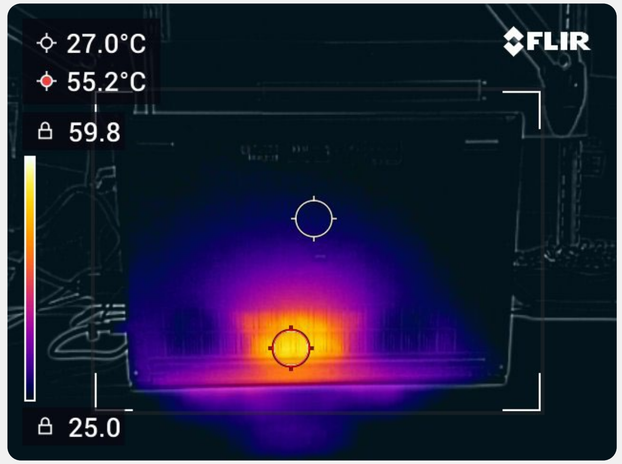


Vivobook S15 with Snapdragon X Elite, C Panel



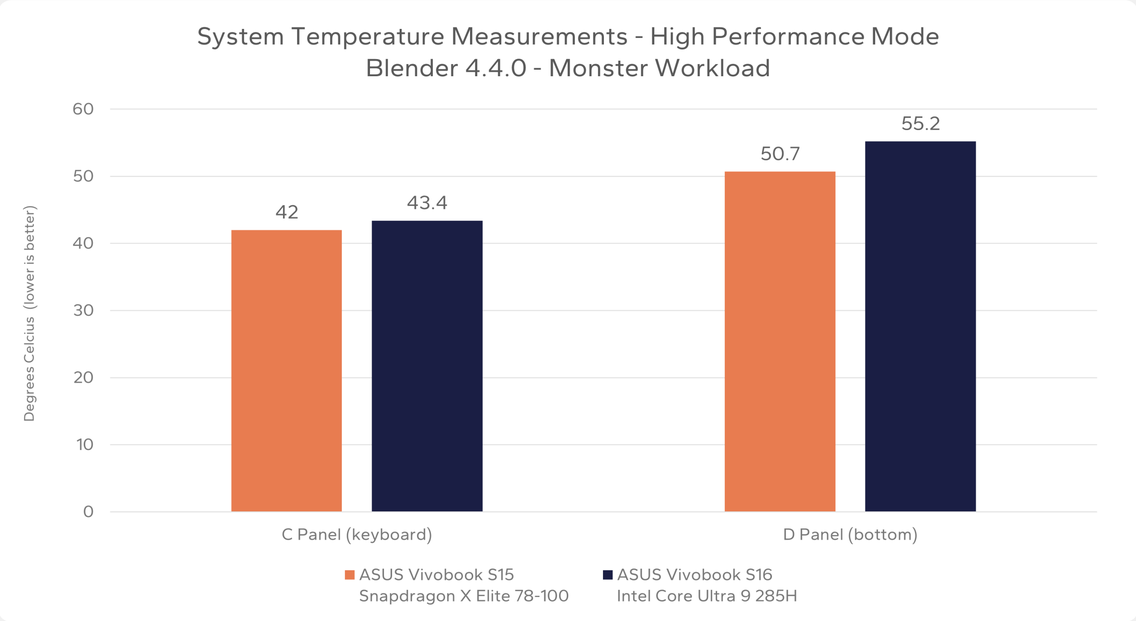
Vivobook S16 with Intel Core Ultra 200H, C Panel

Vivobook S15 with Snapdragon X Elite, D Panel

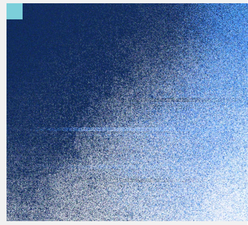


Vivobook S16 with Intel Core Ultra 200H, D Panel

Results: ASUS Vivobook with Blender 4.4.0



Near the end of this workload, the temperatures on the C and D panels on the Intel-based design are higher than those on the Qualcomm-based design. While the difference on the keyboard is minimal at just 1.4C, it jumps to a more significant 4.5C delta on the D panel. This is despite the fact that the Intel laptop has a little more surface area on the chassis to dissipate heat. Considering that Qualcomm achieved much better performance at a lower temperature, the Snapdragon X Elite proves to be a fair bit more efficient than the 285H in this case.



Conclusions

In our testing across a set of three different laptop comparisons, the Snapdragon X Elite is demonstrably better in thermal efficiency and also leading in these tests in terms of pure performance. That is the ideal combination for a CPU and platform design: offer amazing performance and capabilities without running too hot. It accomplished this not only against Intel's competing thin-and-light chip Lunar Lake, but also Intel's Arrow Lake and AMD's Strix Point, which are targeted at the more traditional and mainstream segment of the market.

Just on its own, heat can cause a myriad of issues. An excessive amount of heat can easily make a laptop or any device too hot to comfortably use, whether it's the bottom or the top of the chassis getting hot to the touch. To combat heat, OEMs really only have two options: installing a more powerful cooling solution, or ramping up the fan speed. The former option will almost certainly push up the price of the device, and may also make it heavier. In the latter case, louder fans will obviously annoy users, perhaps to the point where the fans are simply too loud. Users might not consider these points very much when they're looking to buy a laptop, but they'll definitely start caring about it if things get too hot and loud, which can overshadow even good performance and battery life.

There are obviously other comparisons and considerations you could look at, including other OEM designs, comparing different sizes and form factors, and even using other benchmarks or workloads to stress the system. The power management system on Windows laptops is incredibly complex and is really a combination of great silicon design, hardware implementation, and software to manage it all. It can and will vary OEM to OEM, and that's why, with making broad statements, it's key to look at a wide range of options.

One of Qualcomm's key tenets of its Snapdragon X Elite platform launch back in 2024 was its ability to offer leadership CPU performance thanks to its Oryon core, while utilizing its expertise in thermal and power management with its history in smartphone chip design, to build a truly unique Windows experience. Competition is moving all the time, but as we see the market today, Qualcomm has achieved these goals.

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Important Information About this Report

Contact Information
Signal65 | signal65.com | info@signal65.com

Contributors

Matthew Connatser
Technical Analyst - Signal65
Ken Addison
Client Performance Director - Signal65

Publisher

Ryan Shrout
President/GM - Signal65

Inquiries

Contact us if you would like to discuss this report and Signal65 will respond promptly.

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Signal65 exists to be a source of data in a world where technology markets and product landscapes create complex and distorted views of product truth. We strive to provide honest and comprehensive feedback and analysis for our clients in order for them to better understand their own competitive positioning and create optimal opportunities to market and message their devices and services.

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SNAPDRAGON X SERIES OFFERS LEADERSHIP EFFICIENCY AND THERMALS FOR WINDOWS LAPTOPS

System Configurations

	Dell XPS 13	Dell XPS 13
CPU	Snapdragon X Elite 80-100	Intel Core Ultra 7 256V
Graphics	Qualcomm Adreno X1-85	Intel Arc 140V
RAM	16GB LPDDR5X-8533	16GB LPDDR5X-8533
Storage	512GB Western Digital SN740	512GB Micron 2250
Display	13” 2880x1800	13” 1920x1200
System BIOS	2.5.0	1.8.0
Operating System	Windows 11 26100.3775	Windows 11 26100.3775
Windows Power Mode	Balanced	Balanced
OEM Power Mode	Optimized	Optimized
Virtualization Based Security	Enabled	Enabled

	ASUS Vivobook S15	ASUS VivobookS16
CPU	Snapdragon X Elite 78-100	Intel Core Ultra 9 285H
Graphics	Qualcomm Adreno X1-85	Intel Arc 140T
RAM	16GB LPDDR5X-8533	32GB LPDDR5X-7467
Storage	1TB Micron MTFDKBA1T0QFM	1TB Micron MFTDKBA1T0QGN
Display	15” 2880x1620	16: 2880x1800
System BIOS	S550QAD.362	S5606CA.305
Operating System	Windows 11 26100.3476	Windows 11 26100.3476
Windows Power Mode	Best Performance	Best Performance
OEM Power Mode	Performance	Performance
Virtualization Based Security	Enabled	Enabled

	Acer Swift 14	Acer Swift 14	Acer Swift 14
CPU	Snapdragon X Elite 78-100	Intel Core Ultra 7 258V	AMD Ryzen AI 9 365
Graphics	Qualcomm Adreno X1-85	Intel Arc 140V	AMD Radeon 880M
RAM	16GB LPDDR5X-8533	32GB LPDDR5X-8533	32GB LPDDR5X-7500
Storage	1TB Western Digital PC SN5000S	1TB Micron 2250	1TB Western Digital PC SN5000S
Display	14.5” 2560x1600	14” 1920x1200	14” 1920x1200
System BIOS	1.18	1.12	1.08
Operating System	Windows 11 26100.3476	Windows 11 26100.3476	Windows 11 26100.3476
Windows Power Mode	Best Performance	Best Performance	Best Performance
OEM Power Mode	Performance	Performance	N/A
Virtualization Based Security	Enabled	Enabled	Enabled

Applications Used

Blender 4.4.0

UL Procyon 2.10.1663


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