AORUS

X570
OVERCLOCKING GUIDE

GIGABYTE™

GIGABYTE AM4 Guide to Overclocking AMD 3rd Gen Ryzen™ (Matisse)-Series Processors

Chapter 1: Intro

Matisse innovates

After the establishment of AMD as a top competitor in the gaming field last year, this year AMD brings the innovation to mainstream computing. More cores, a lot more cores, faster IPC and a larger performance improvement, not to mention the PCI Express 4.0 interface that pushes the speeds on the storage department to a new era.
Read on to learn how to get even more value out of your 3rd Gen AMD Ryzen processor.

Chapter 2: How to Overclock Your 3rd Gen AMD Ryzen CPU

For reference we are using a GIGABYTE X570 AORUS MASTER motherboard, an AMD Ryzen 9 3950X processor, 16GB AORUS DDR4 3200Mhz, and a liquid cooler, the EK-KIT P360.
Based on our testing the AMD Ryzen 9 3950X can hit around 4.3 GHz using around 1.4V Vcore. In this guide we will be targeting a frequency of 4.3GHz on all the cores from a stock frequency of 3.3 GHz.

Disclaimer: Overclocking will technically void your warranty. While it's usually safe, there is potential to damage the chip if you push voltages too high.

Taking Your CPU to the Next Level – Overclocking

Simply follow the steps below and you'll be enjoying your overclocked Ryzen powerhouse in no time.
Although AMD Ryzen 9 3950X processors have a Max Boost frequency of 4.7 GHz, that only applies on two cores. Our goal is to overclock all 16 cores of this part at the maximum possible speed.

Step 1: Enter the BIOS

Enter the BIOS by restarting your computer and pressing the “delete” button before the OS launches.

Step 2: Enter “Tweaker” tab

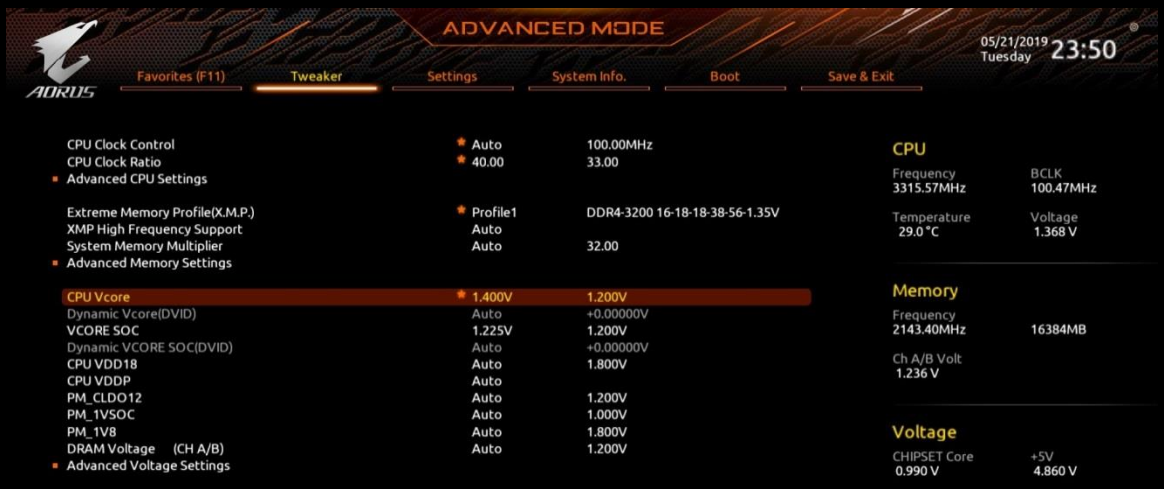
Change your “CPU Clock Ratio” to “43.00”. A CPU clock ratio of 43 multiplied by 100 which is our default “CPU Clock Control” gives you a frequency of 4300 MHz.
The CPU comes with a default CPU frequency of 3300 MHz, which means that it has a default “CPU Clock Ratio” of “33.00” and a default “CPU Clock Control” of “100”.
Interesting fact! We noticed that if you look in CPU-Z while running at default clocks, the frequency jumps up and down. This is the power saving settings at work. Once you overclock and increase your “CPU Clock Ratio” to any value above the default setting of “33.00” the measured frequency stops going up and down.
Different from Intel’s, “CPU Clock Ratio” can be adjusted in increments of 0.25x instead of 1.0x. For example “CPU Clock Ratios” of 33.25, 33.50, 33.75 etc are possible.

Step 3: Adjust Your Voltage Settings

Now we have tuned almost all the features and the frequencies of our CPU but in order for the CPU to work at a higher speed it needs to be supplied with higher voltage.
Go to the starting BIOS page (Tweaker) and scroll down to the voltage options.

3a. Change CPU Vcore:

Raising this helps keep the system stable at higher CPU frequencies. However, it also increases the amount of heat your CPU produces. We suggest you to keep Vcore from 1.3 to 1.45v when overclocking to around 4 GHz–however—CPUs differ, some require higher voltages to be stable, some lower. There's a large component of luck involved.



3b. Adjust the rest of the Voltage Settings if necessary

These are the same settings that exist on the previous AMD Chipset motherboards too. For a little extra boost in stability while overclocking we suggest you to try to change VCORE SOC up to 1.20-1.25 volts when using standard air or liquid cooling. For CPU VDD18 you can adjust it up to 2.0 volts and for CPU VDDP up to +0.2 volts if this is required from the CPU you are testing. It wasn't necessary for us. The PM_CLDO12, PM_1VSOC and the PM_1V8 you can adjust them up to 1.25V, 1.2V and 1.84V if your system is not stable without them at Auto.

3c. Adjust CPU Loadline Calibration Setting

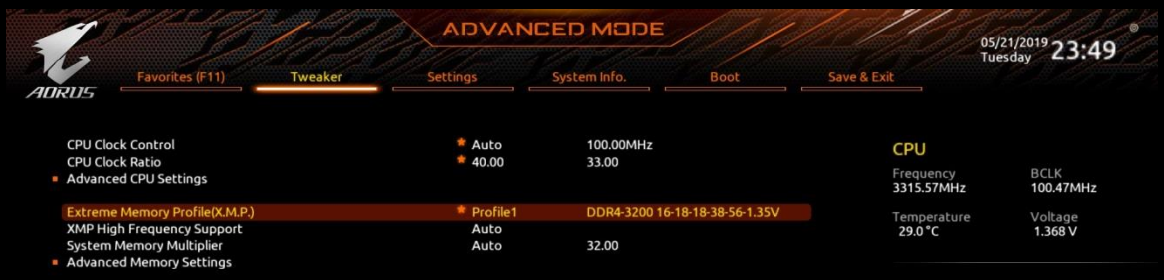
If you need some extra stability adjust this setting to either “High” or “Turbo”. You may notice that after this adjustment your CPU Vcore is higher. This option is located in the “Advanced Voltage Settings” submenu.

■ Step 4: Optimize Your Memory Settings

There are two different methods of optimizing your memory settings, the easy way is through the Extreme Memory Profile (X.M.P.) option, and the more difficult way is through manually adjusting your ram settings.

4a. Easy Way

Go back to the “Tweaker” starting page. Here you see the “Extreme Memory Profile (X.M.P.)” option. Enable it. The system will choose the optimal memory frequency and DRAM timings for you.



4b. More Difficult Way

AMD now supports higher memory dividers. Select the frequency that your memory sticks run at. Since X.M.P. is not enabled, your memory timings will be automatically set by the CPU. Next, go back to “Tweaker” and adjust the DRAM Voltage option. Set your DRAM Voltage to your specific memory module’s recommended voltage setting.

Now that you’ve set your overclocks, it’s time to make sure that your system is stable!

Chapter 3: Stability Testing & Results

Congratulations! You have obtained a clock rate of around 4 GHz. Now it's time to make sure that it's stable. We're going to use the software below to monitor our system, stability test, and adjust our overclocks.

Prime95 – This is used to stress test our CPU in order to ensure that it's stable in the most taxing of conditions.

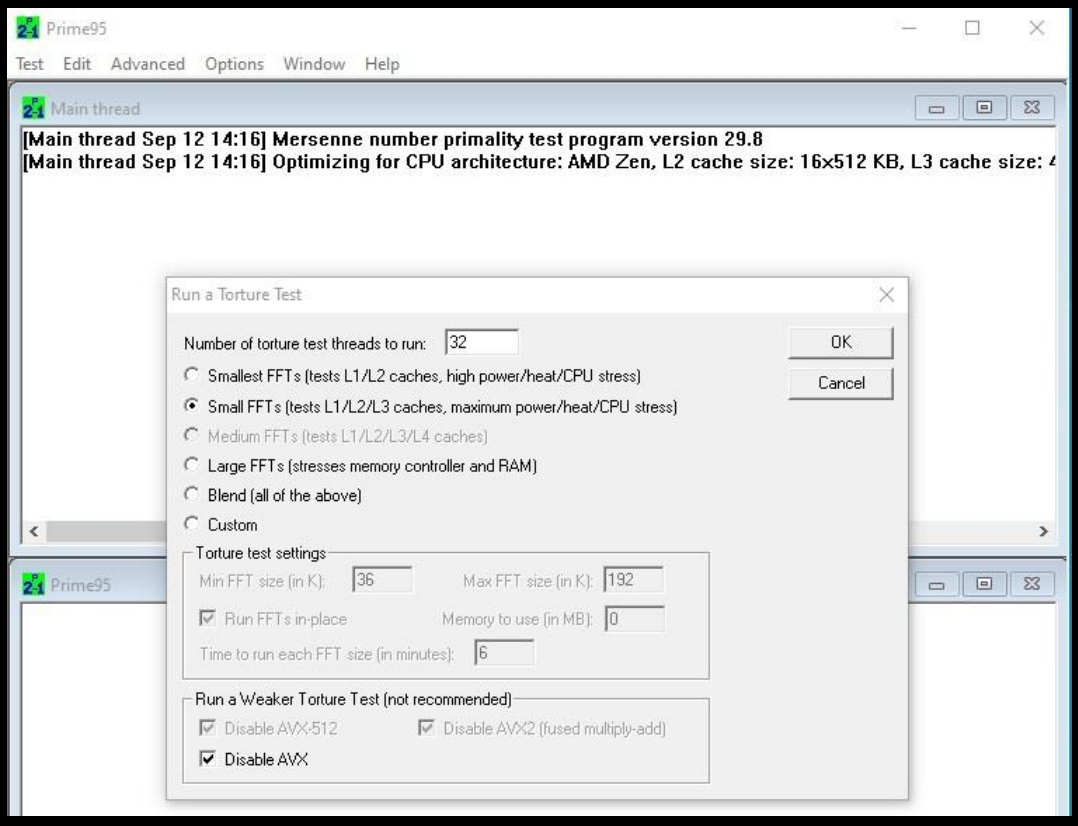
CPU-Z – Used to monitor our CPU frequencies. Latest version is preferred.

HWiNFO – Used to monitor idle and load temperatures and Vcore settings.

How to Stability Test

■ Step 1: Prepare Stability Testing and Monitoring Applications

Open up CPU-Z, HWiNFO, and Prime95 so you are able to stress test and monitor CPU temperature, frequency, and memory timings all on the same screen. Disable the AVX options or if you want to test AVX, you will obtain lower frequencies since the load on the CPU will be much higher.



Step 2 : Start Prime95

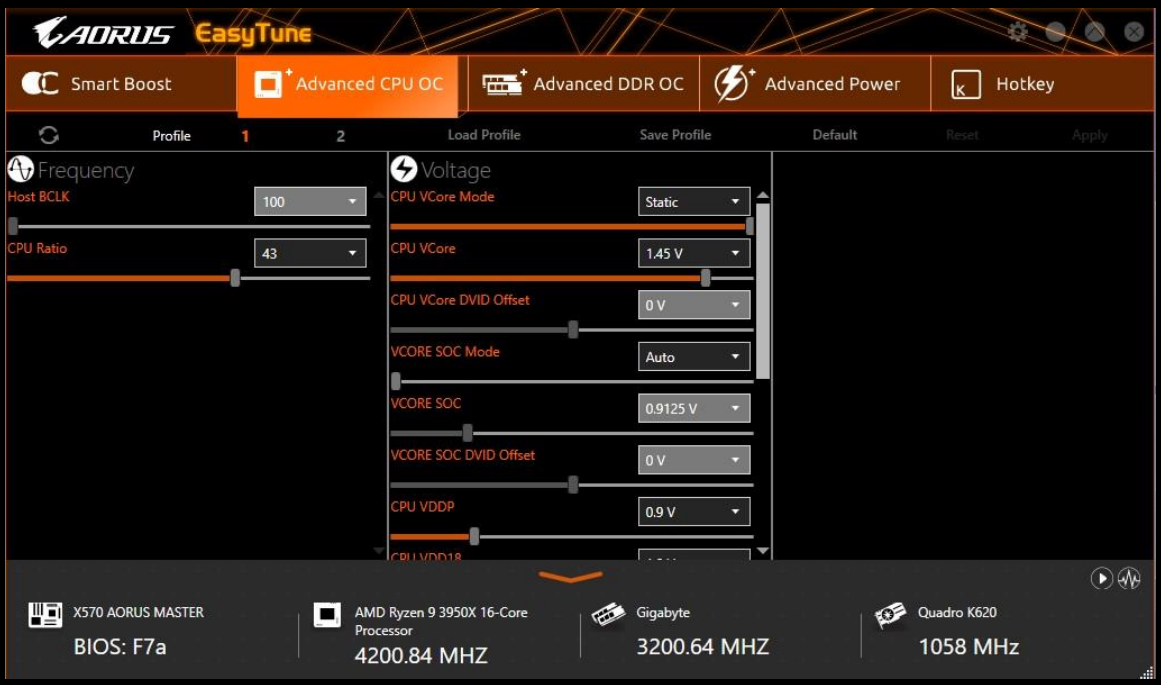
After starting the Prime95 torture test, highlight the Prime95 tray icon—all cores should say “self-test”, if it shows “not working” that means that specific core has failed to pass the test. Another form of failing the stability test is that your system may simply just reboot or freeze, which means your settings were too aggressive and your CPU has failed the stability test. We normally test Prime95 for 30 minutes. This duration can be increased for more assurance.

Step 3a (Fail) : Close Prime95

Close Prime95 by right clicking the Prime95 icon on the tray bar in the lower right side of your screen and selecting “Exit”. This closes Prime95.

Step 3b (Fail) : Adjust Frequency or Voltage

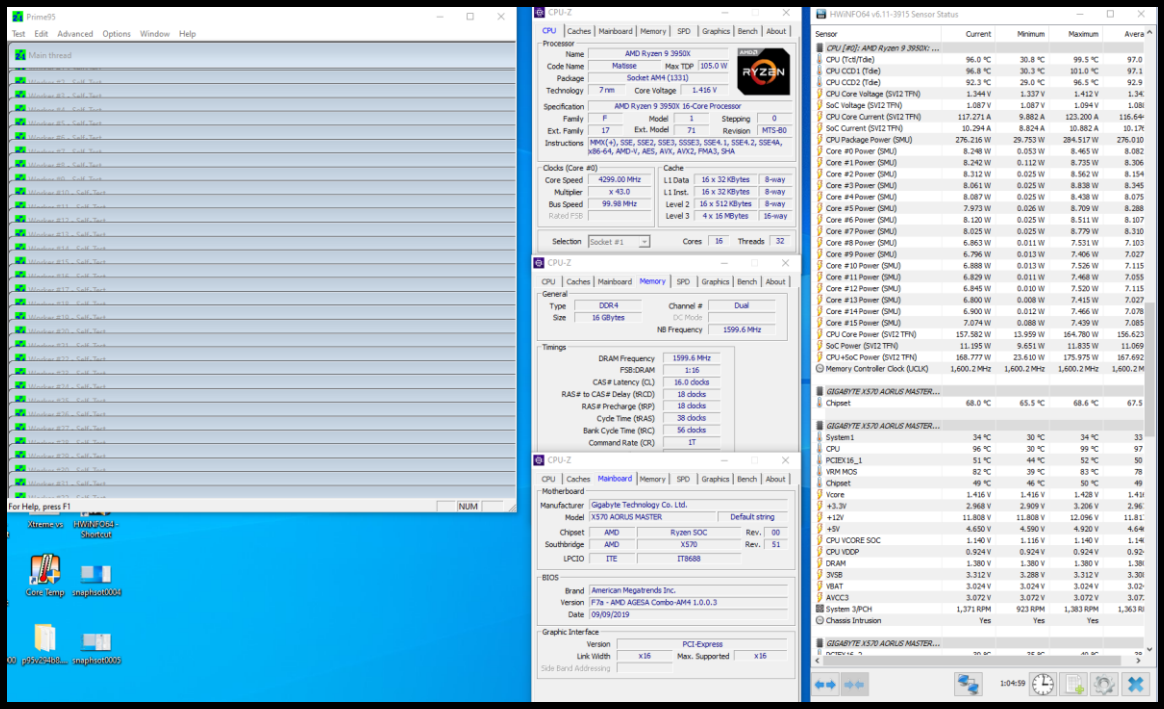
Now it’s time to adjust your frequency or voltage settings. You can do this either through the BIOS or using EasyTune which is available through the GIGABYTE App Center. You have two options: Either increase CPU Vcore or decrease “CPU Clock Control”. We recommend you to stay under 95° C on your CPU along with a CPU Vcore below 1.45 volts if possible. After making adjustments go back to Step 1. If it continues to fail, dial down your “CPU Clock Control” until you pass stability testing.



Step 4 (Success): Enjoy Overclock or Increase Frequency

Congratulations, your current overclock is stable. You may want to try for a higher frequency. To do so, experiment with raising your CPU Clock Control and CPU Vcore settings either in BIOS or EasyTune and go back to Step 1 for stability testing to ensure that it's stable.

The below picture shows a 4.3 GHz OC on liquid cooling passing 1 hour of stability testing:



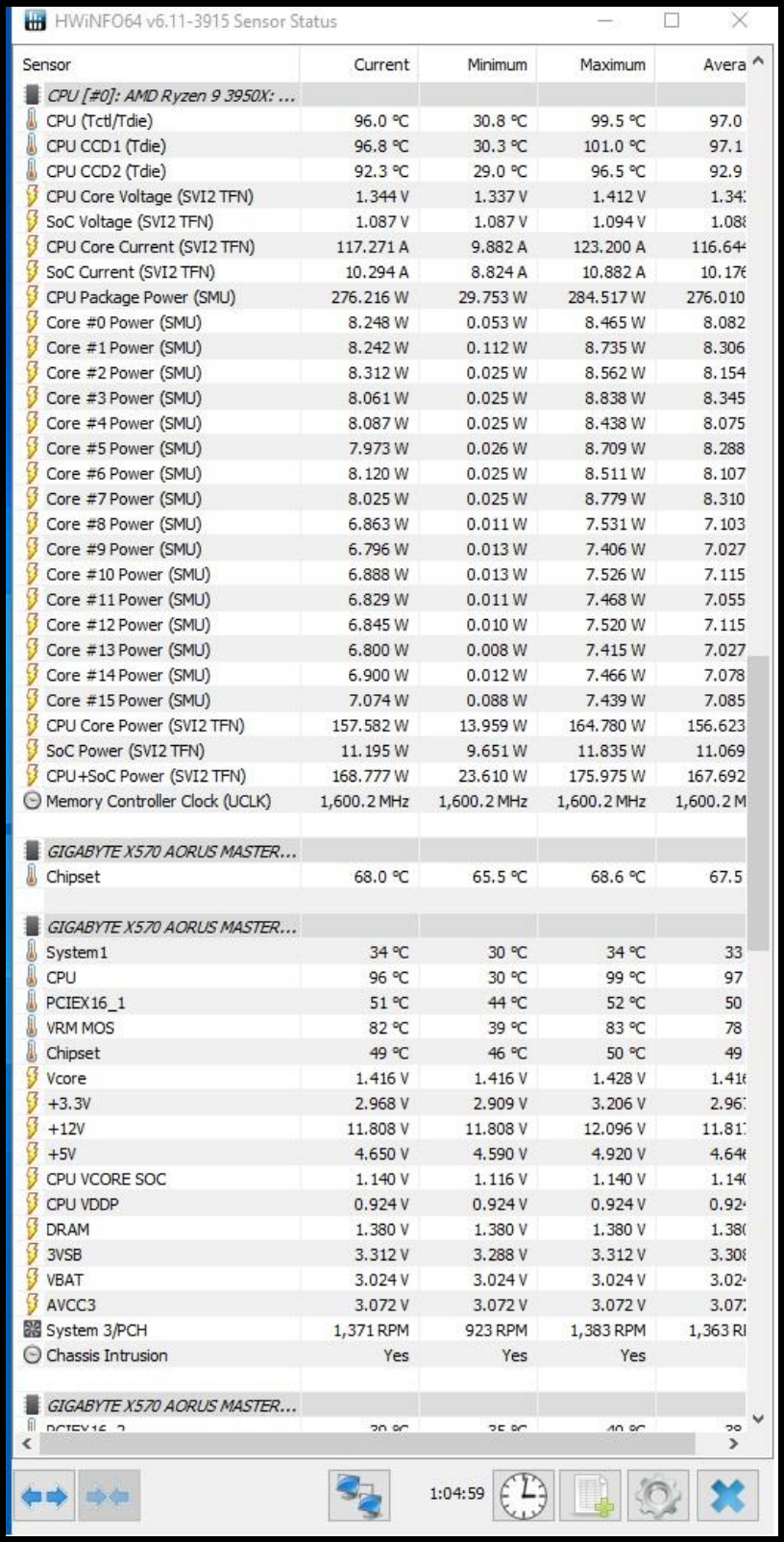
Thermals

We ran tests using a liquid cooling setup at different voltages and frequencies using an AMD Ryzen 9 3950X to show the difference in thermal performance. As you can see with our liquid cooling setup the temperatures are similar than what we were getting last year using a Ryzen 7 2700X.

Our Liquid Cooling Setup

Liquid cooler: EK-KIT P360

Motherboard: GIGABYTE X570 AORUS MASTER



HWiNFO64 v6.11-3915 Sensor Status

Sensor	Current	Minimum	Maximum	Avera
CPU [#0]: AMD Ryzen 9 3950X: ...				
CPU (Tctl/Tdie)	96.0 °C	30.8 °C	99.5 °C	97.0
CPU CCD1 (Tdie)	96.8 °C	30.3 °C	101.0 °C	97.1
CPU CCD2 (Tdie)	92.3 °C	29.0 °C	96.5 °C	92.9
CPU Core Voltage (SVI2 TFN)	1.344 V	1.337 V	1.412 V	1.34
SoC Voltage (SVI2 TFN)	1.087 V	1.087 V	1.094 V	1.08
CPU Core Current (SVI2 TFN)	117.271 A	9.882 A	123.200 A	116.64
SoC Current (SVI2 TFN)	10.294 A	8.824 A	10.882 A	10.17
CPU Package Power (SMU)	276.216 W	29.753 W	284.517 W	276.010
Core #0 Power (SMU)	8.248 W	0.053 W	8.465 W	8.082
Core #1 Power (SMU)	8.242 W	0.112 W	8.735 W	8.306
Core #2 Power (SMU)	8.312 W	0.025 W	8.562 W	8.154
Core #3 Power (SMU)	8.061 W	0.025 W	8.838 W	8.345
Core #4 Power (SMU)	8.087 W	0.025 W	8.438 W	8.075
Core #5 Power (SMU)	7.973 W	0.026 W	8.709 W	8.288
Core #6 Power (SMU)	8.120 W	0.025 W	8.511 W	8.107
Core #7 Power (SMU)	8.025 W	0.025 W	8.779 W	8.310
Core #8 Power (SMU)	6.863 W	0.011 W	7.531 W	7.103
Core #9 Power (SMU)	6.796 W	0.013 W	7.406 W	7.027
Core #10 Power (SMU)	6.888 W	0.013 W	7.526 W	7.115
Core #11 Power (SMU)	6.829 W	0.011 W	7.468 W	7.055
Core #12 Power (SMU)	6.845 W	0.010 W	7.520 W	7.115
Core #13 Power (SMU)	6.800 W	0.008 W	7.415 W	7.027
Core #14 Power (SMU)	6.900 W	0.012 W	7.466 W	7.078
Core #15 Power (SMU)	7.074 W	0.088 W	7.439 W	7.085
CPU Core Power (SVI2 TFN)	157.582 W	13.959 W	164.780 W	156.623
SoC Power (SVI2 TFN)	11.195 W	9.651 W	11.835 W	11.069
CPU+SoC Power (SVI2 TFN)	168.777 W	23.610 W	175.975 W	167.692
Memory Controller Clock (UCLK)	1,600.2 MHz	1,600.2 MHz	1,600.2 MHz	1,600.2 M
GIGABYTE X570 AORUS MASTER...				
Chipset	68.0 °C	65.5 °C	68.6 °C	67.5
GIGABYTE X570 AORUS MASTER...				
System1	34 °C	30 °C	34 °C	33
CPU	96 °C	30 °C	99 °C	97
PCIEX16_1	51 °C	44 °C	52 °C	50
VRM MOS	82 °C	39 °C	83 °C	78
Chipset	49 °C	46 °C	50 °C	49
Vcore	1.416 V	1.416 V	1.428 V	1.41
+3.3V	2.968 V	2.909 V	3.206 V	2.96
+12V	11.808 V	11.808 V	12.096 V	11.81
+5V	4.650 V	4.590 V	4.920 V	4.64
CPU VCORE SOC	1.140 V	1.116 V	1.140 V	1.14
CPU VDDP	0.924 V	0.924 V	0.924 V	0.92
DRAM	1.380 V	1.380 V	1.380 V	1.38
3VSB	3.312 V	3.288 V	3.312 V	3.30
VBAT	3.024 V	3.024 V	3.024 V	3.02
AVCC3	3.072 V	3.072 V	3.072 V	3.07
System 3/PCH	1,371 RPM	923 RPM	1,383 RPM	1,363 RI
Chassis Intrusion	Yes	Yes	Yes	
GIGABYTE X570 AORUS MASTER...				

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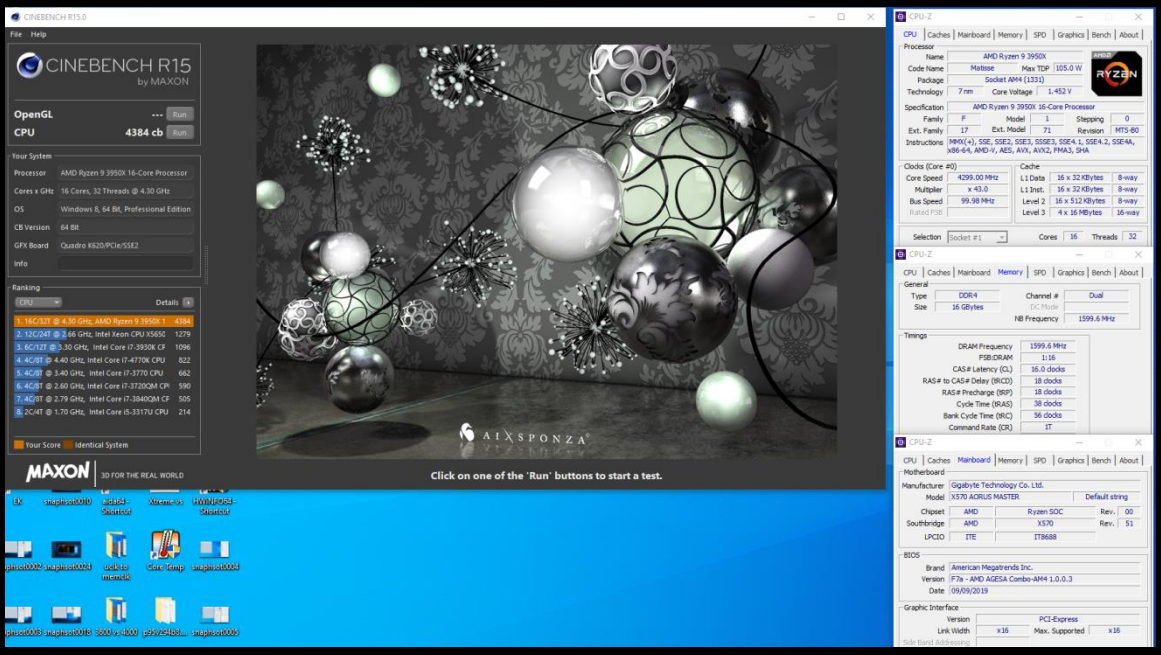
Results

At a stock frequency we obtained 3932 cb on Cinebench R15.



At our goal of 4.3 GHz while using memory XMPs at a frequency of 3200 MHz, we obtained a Cinebench R15 score of 4384 cb. **That's a 452 point difference!**

Chapter 4: Pushing Past 4.3 GHz

Although 4.3 GHz might be the limit for many parts, there are parts that can be overclocked even higher. Not in all occasions are these results going to assure you the prime95 stability but at least the parts might be able to be stable through Cinebench R15. We recommend using reliable dual-radiator water cooling or even better, a triple-radiator solution for the best results. For the specific steps please refer to the overclocking guide above.
Follow the previous steps and just adjust the settings to the new values. With that said, we don’t suggest you to do it since the CPU voltages that you need to achieve such results are quite high and may damage your parts.

For experimental purposes only, we tried how high our part could pass Cinebench R15. Unfortunately, this time we weren’t able to test multiple parts so we can only base our experience on a single part.

And Cinebench R15 at 4400 MHz.