AORUS

X470 OVERCLOCKING GUIDE

GIGABYTE™

GIGABYTE AM4 Guide to Overclocking AMD Ryzen (Pinnacle Ridge)-Series Processors

Chapter 1: Intro

Pinnacle Ridge establishes the return of AMD

With the release of Ryzen™ last year, AMD processors were back in the competition. Pinnacle Ridge, built on the AM4 socket, brings a larger performance improvement, bigger overclocking headroom and it fixes many bugs the first Ryzen processors had—all at a competitive price. Read on to learn how to get even more value out of your AMD Pinnacle Ridge processor.

Chapter 2: How to Overclock Your AMD Ryzen 2700X CPU

For reference, we are using a GIGABYTE X470 AORUS Gaming 7 WIFI motherboard, an 2700X AMD Ryzen 7 processor, 16GB G.Skill DDR4 Trident Z 3600Mhz, and a liquid cooler, the Lepa AquaChanger 240 All-In-One.

Based on our testing, most Ryzen 2700X processors can hit around 4.2GHz on All-In-One coolers using a 1.25-1.35V Vcore. In this guide, we will be targeting a frequency of 4.2GHz from a stock frequency of 3.7 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 Ryzen 7 2700X has a Max Boost frequency of 4.3GHz, that only applies on one core. Our goal is to overclock all the 8 cores of the 2700X at the maximum possible speed. An average past should be able to hit 4.2GHz for prime95, which is our goal.

■ Step 1: Enter the BIOS

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

■ Step 2: Enter “Advanced Frequency Settings”

Change your “CPU Clock Ratio” to “42.00”. A CPU clock ratio of 42 multiplied by 100 which is our default “Host Clock Value” gives you a frequency of 4200 MHz.

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 about the default setting of “37.00” the measured frequency stops going up and down.

Different from Intel, “CPU Clock Ratio” can be adjusted in increments of 0.25x instead of 1.0x. For example “CPU Clock Ratios” of 37.25, 37.50, 37.75 etc are possible.

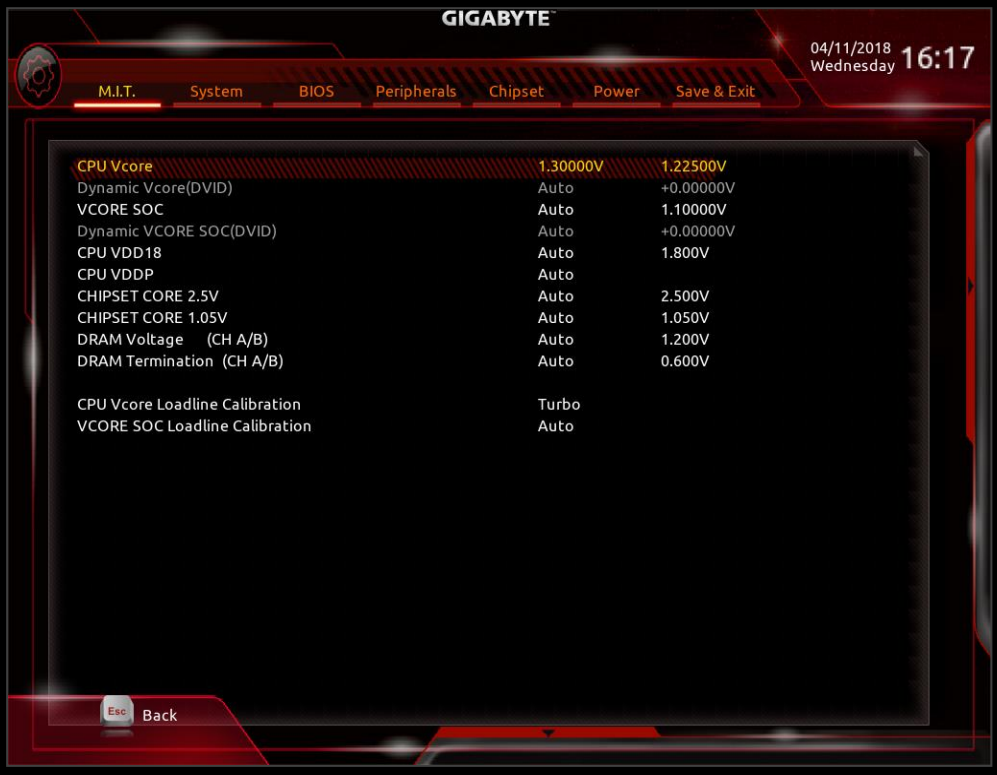
Aside from the small steps on the “CPU Clock Ratio” the users have the ability to squeeze every last drop of performance of their parts by adjusting the “Host Clock Value”.

For example the CPU comes with a default CPU frequency of 3700 MHz, which means that it has a default “CPU Clock Ratio” of “37.00” and a default “Host Clock Value” of “100”. If we want to overclock this CPU to 4166MHz we can simply change the “CPU Clock Ratio” to 41.00 and the “Host Clock Value” to 101.6MHz.
Changing the “Host Clock Ratio” will affect the Memory frequency and the NB frequency.

■ 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 (M.I.T.) and select the “Advanced Voltage Settings” option.

3a. Change CPU Vcore: Raising this helps keeps 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 1.25 to 1.35v when overclocking to around 4.2GHz–however—CPUs differ, some require higher voltages to be stable, some lower. There's a large component of luck involved.



3b. Adjust the Three New Voltage Settings: VCORE SOC, CPU VDD18, CPU VDDP

These are the same settings that exist on previous AMD Chipset motherboards too. For a little extra boost in stability while overclocking we suggest you 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 2.1 volts and up to +0.2 volts for CPU VDDP if this is required from the CPU you are testing.

3c. Adjust CPU Loadline Calibration Setting

If you need some extra stability, adjust this setting to either "Turbo" or "Extreme". You may notice that after this adjustment your CPU Vcore is higher.

■ Step 4: Optimize Your Memory Settings

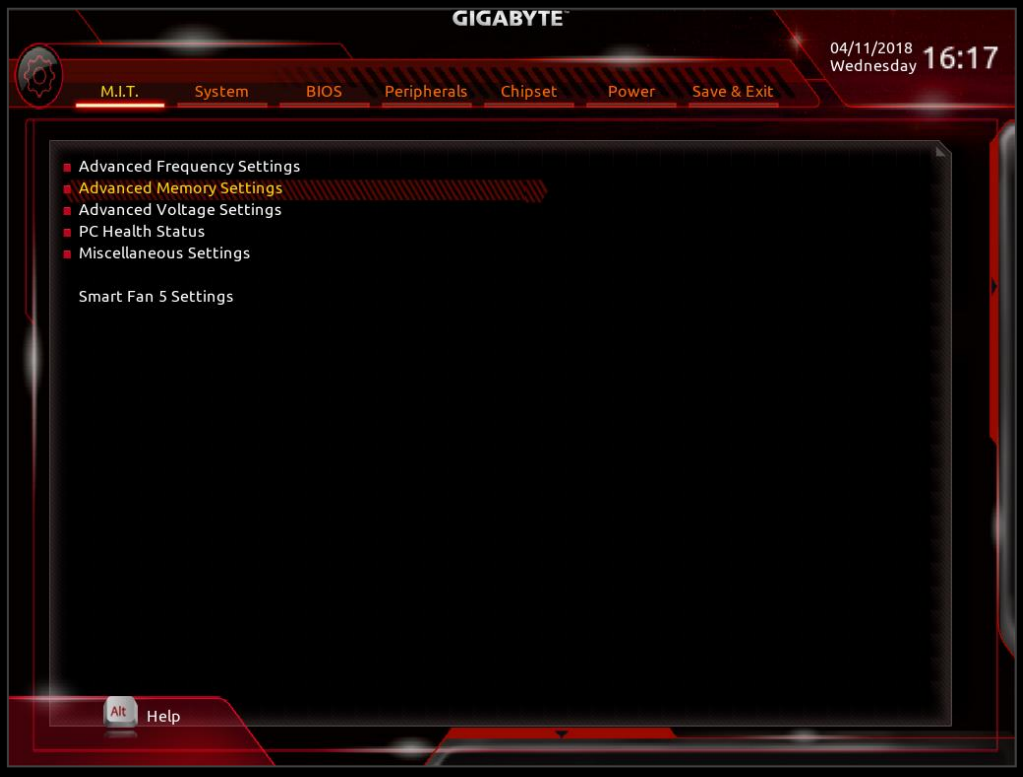
There are two different methods of optimizing your memory settings, the easy way through the Extreme Memory Profile (X.M.P.) option, and the more difficult way through manually adjusting your ram settings.

4a. Easy Way

Go back to the “M.I.T.” starting page. Select “Advanced Memory Settings”. 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 from the X470 higher memory dividers as when the X370 chipset launches. You should be able to see higher frequencies than 3200 Mhz. 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 “M.I.T.” and select “Advanced Voltage Settings”. Set your DRAM Voltage to your specific memory modules’ 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 4.2 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.

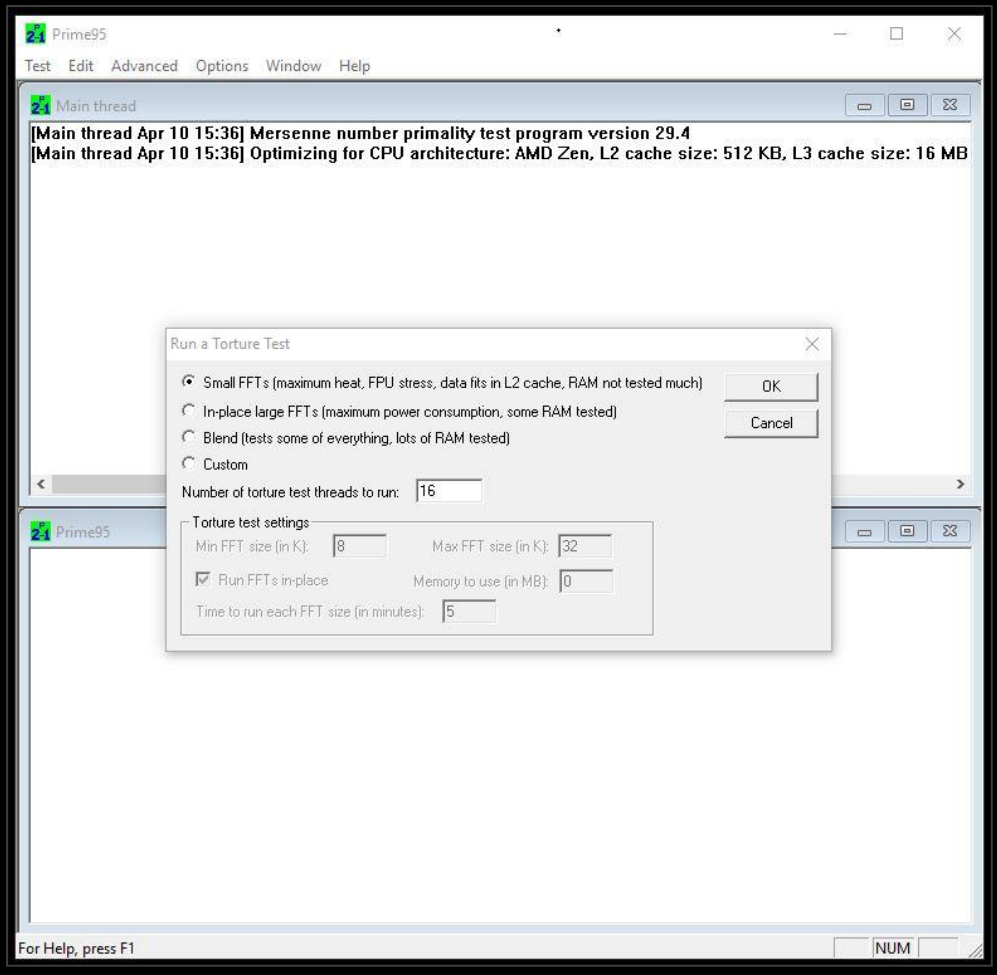
CPU-Z – Used to monitor our CPU frequencies. Version 1.84 is preferred.

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.



■ Step 2: Start Prime95

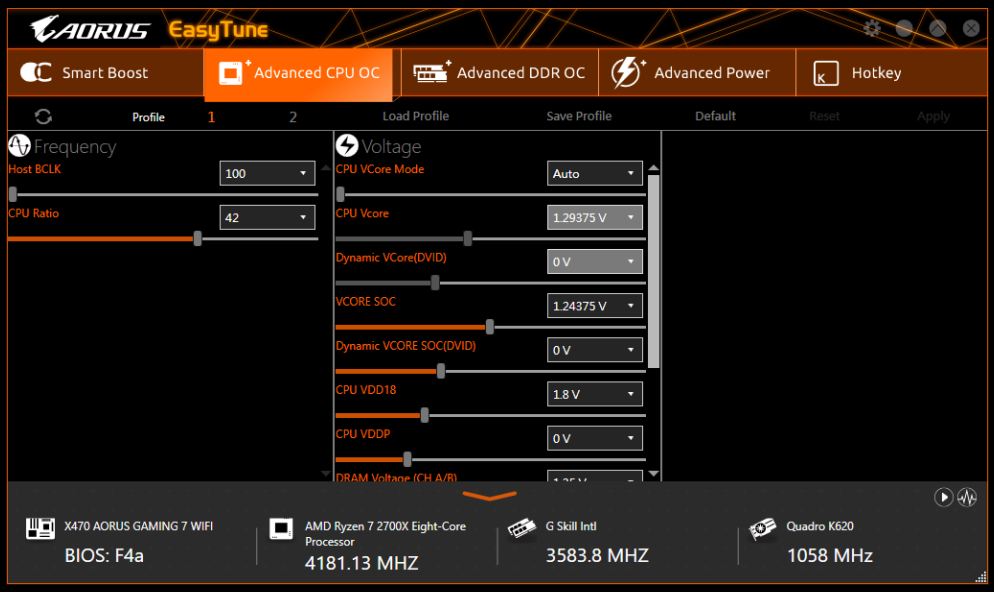
After starting the Prime95 torture test highlight the Prime95 tray icon—all cores should say “self-test”, if it shows “not working” that means that specific core has failed to pass the test. Another form of failing the stability test is that your system may simply just reboot or freeze, which means your settings were too aggressive and your CPU has failed the stability test. We normally test Prime95 for 1 hour. This duration can be increased for more assurance.
The Small FFTs is considered the most extreme torture test for Prime95 so the other torture test options are more than sufficient as well as practical to use.

■ 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

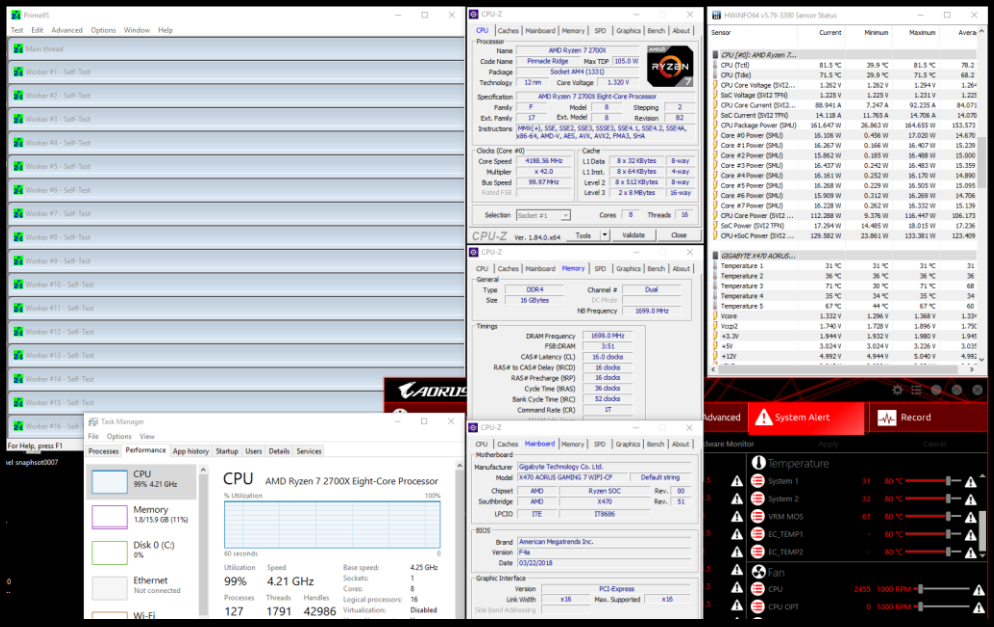
Now it’s time adjust your frequency or voltage settings. You can do this either through the BIOS or using EasyTune which is available through the GIGABYTE App Center. You have two options: Either increase CPU Vcore or decrease “CPU Clock Control”. We recommend you to stay under 90° C on your CPU along with a CPU Vcore below 1.4 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 4.2 GHz OC on liquid cooling passing 1 hour of stability testing:

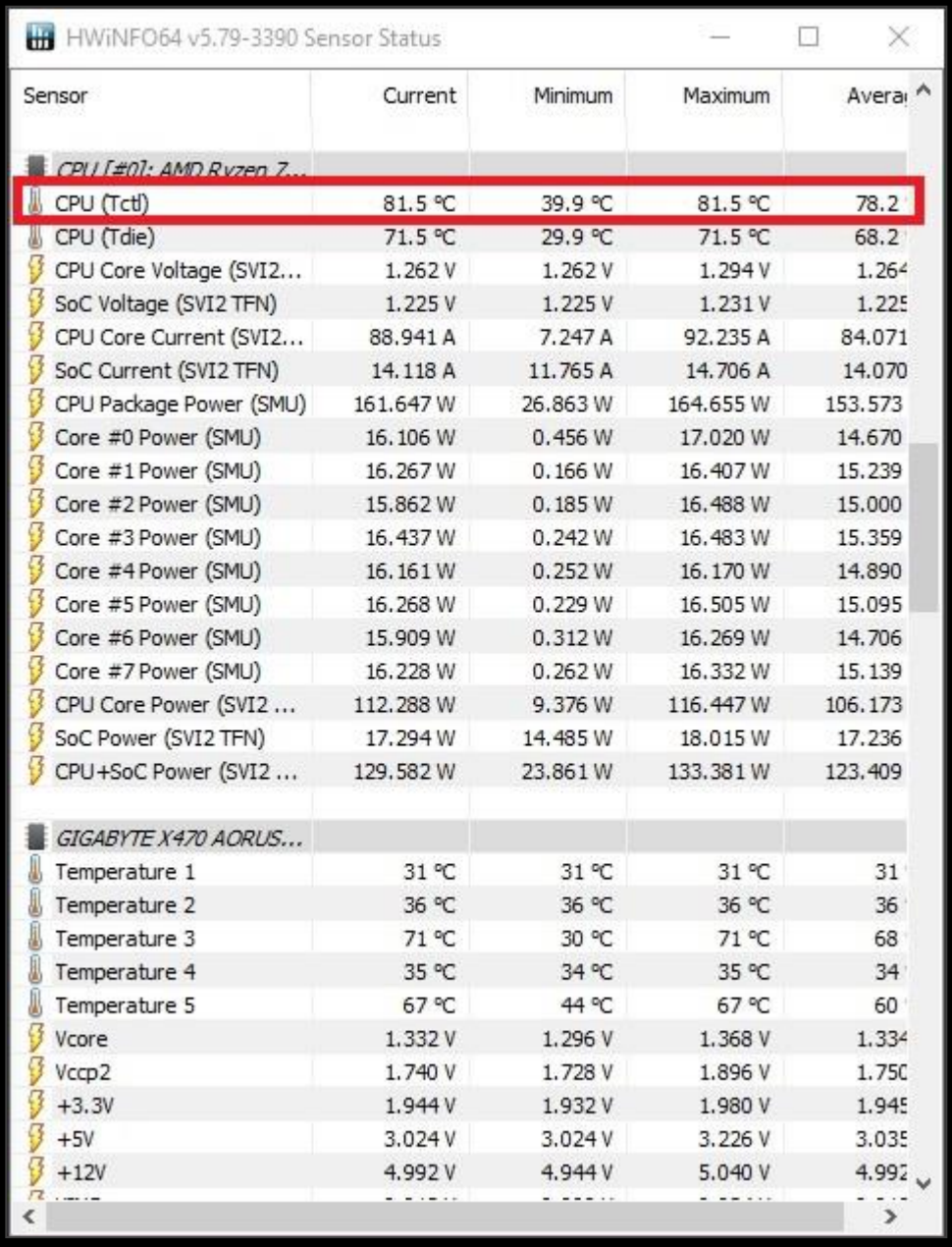


Thermals

We ran tests using a liquid cooling setup at different voltages and frequencies using an AMD Ryzen 7 2700X to show the difference in thermal performance. As you can see with our liquid cooling setup, the temperatures are lower than what we were getting last year using a Ryzen 1800X. This probably allows us to push the processor at a higher speed than last year as well.

Our Liquid Cooling Setup

Liquid cooler: Lepa AquaChanger 240 All-In-One CPU Liquid Cooler
Motherboard: AORUS X470 GAMING 7 WIFI



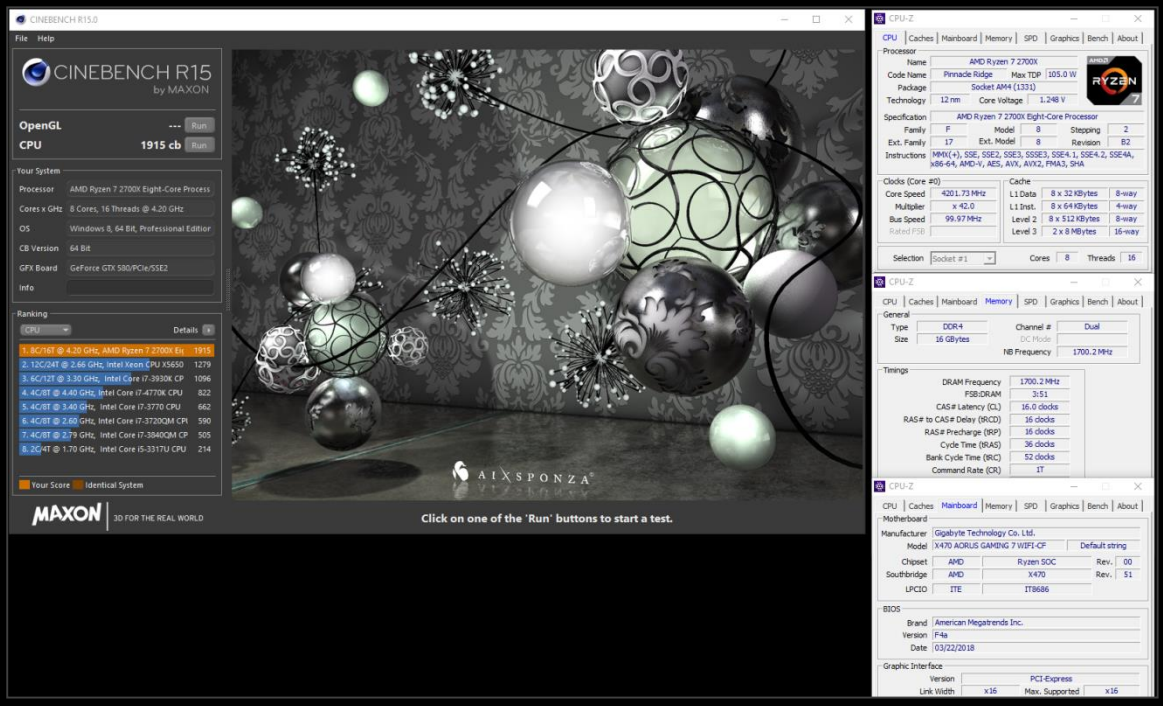
Sensor	Current	Minimum	Maximum	Avera
CPU [#0]: AMD Ryzen 7...				
CPU (Tctl)	81.5 °C	39.9 °C	81.5 °C	78.2
CPU (Tdie)	71.5 °C	29.9 °C	71.5 °C	68.2
CPU Core Voltage (SVI2...	1.262 V	1.262 V	1.294 V	1.264
SoC Voltage (SVI2 TFN)	1.225 V	1.225 V	1.231 V	1.225
CPU Core Current (SVI2...	88.941 A	7.247 A	92.235 A	84.071
SoC Current (SVI2 TFN)	14.118 A	11.765 A	14.706 A	14.070
CPU Package Power (SMU)	161.647 W	26.863 W	164.655 W	153.573
Core #0 Power (SMU)	16.106 W	0.456 W	17.020 W	14.670
Core #1 Power (SMU)	16.267 W	0.166 W	16.407 W	15.239
Core #2 Power (SMU)	15.862 W	0.185 W	16.488 W	15.000
Core #3 Power (SMU)	16.437 W	0.242 W	16.483 W	15.359
Core #4 Power (SMU)	16.161 W	0.252 W	16.170 W	14.890
Core #5 Power (SMU)	16.268 W	0.229 W	16.505 W	15.095
Core #6 Power (SMU)	15.909 W	0.312 W	16.269 W	14.706
Core #7 Power (SMU)	16.228 W	0.262 W	16.332 W	15.139
CPU Core Power (SVI2 ...	112.288 W	9.376 W	116.447 W	106.173
SoC Power (SVI2 TFN)	17.294 W	14.485 W	18.015 W	17.236
CPU+SoC Power (SVI2 ...	129.582 W	23.861 W	133.381 W	123.409
GIGABYTE X470 AORUS...				
Temperature 1	31 °C	31 °C	31 °C	31
Temperature 2	36 °C	36 °C	36 °C	36
Temperature 3	71 °C	30 °C	71 °C	68
Temperature 4	35 °C	34 °C	35 °C	34
Temperature 5	67 °C	44 °C	67 °C	60
Vcore	1.332 V	1.296 V	1.368 V	1.334
Vccp2	1.740 V	1.728 V	1.896 V	1.750
+3.3V	1.944 V	1.932 V	1.980 V	1.945
+5V	3.024 V	3.024 V	3.226 V	3.035
+12V	4.992 V	4.944 V	5.040 V	4.992

Here's a quick table of the temperatures we obtained:

	Stock frequency	4.2 GHz	4.3 GHz
Idle	38.3 °C	39.9 °C	44.3 °C
Load	72.8 °C	81.5 °C	89.6 °C

Results

At a stock frequency we obtained 1781 cb on Cinebench R15.



At our goal of 4.2 GHz while using memory XMPs at a frequency of 3400 MHz, we obtained a Cinebench R15 score of 1915 cb**. That's a 134 point difference!**

Chapter 4: Pushing Past 4.2+ GHz

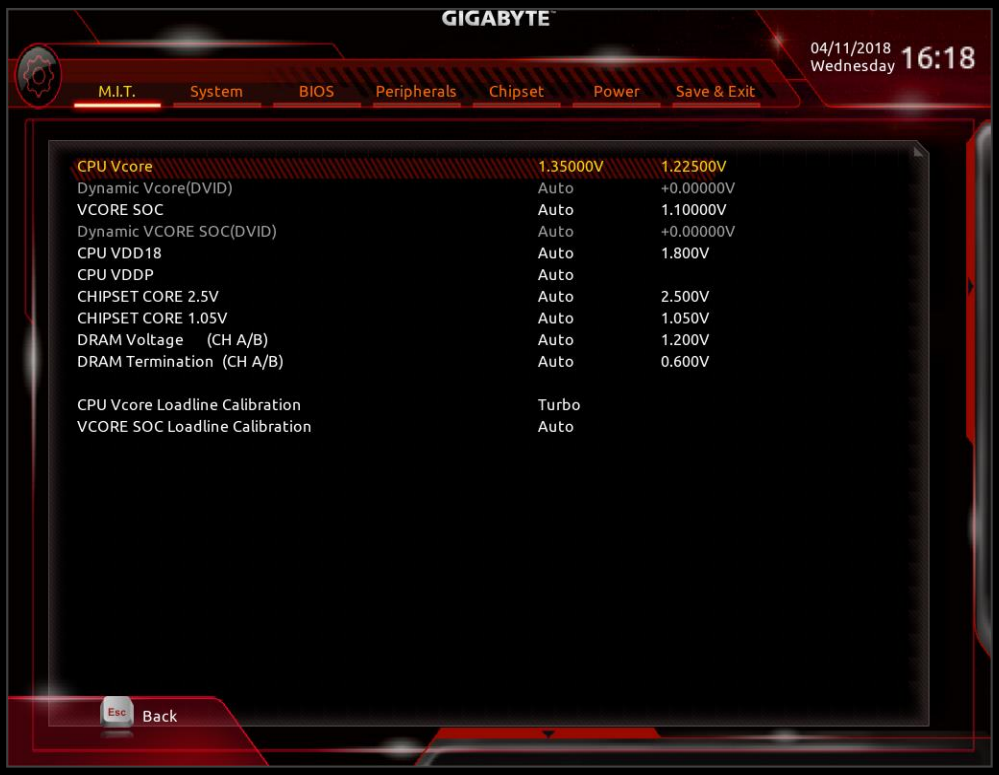
Although 4.2 GHz might be the limit for many parts, there are parts that can be overclocked even higher. Not under all circumstances are these results going to assure you the prime95 stability but at least the parts might be able to be stable through Cinebench R15.
We recommend using reliable dual-radiator water cooling or even better, a triple-radiator solution for the best results. For the specific steps please refer to the overclocking guide above.

■ Step 1: Adjust CPU Clock Ratio

Previously we set our CPU Clock Ratio to 42 and now it's a simple adjustment to 42.5 or even higher. Since this overclock is more difficult than the previous 4.2 GHz overclock, we suggest you change these settings through the BIOS.

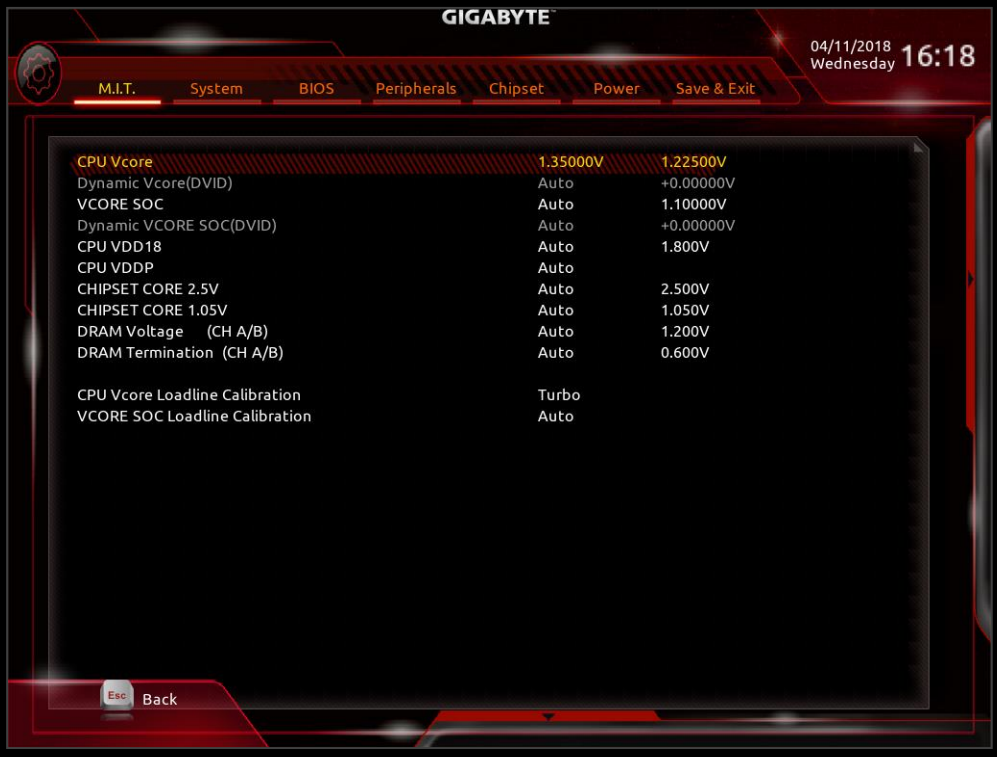
■ Step 2: Adjust CPU Vcore

Since we are aiming for a higher frequency this time, CPU Vcore needs to be increased. Depending on how lucky you were in the CPU lottery, the CPU Vcore setting can range from 1.32V to 1.38V. Our particular CPU needed 1.35 V to be stable.



■ Step 3: Change CPU Vcore Loadline Calibration

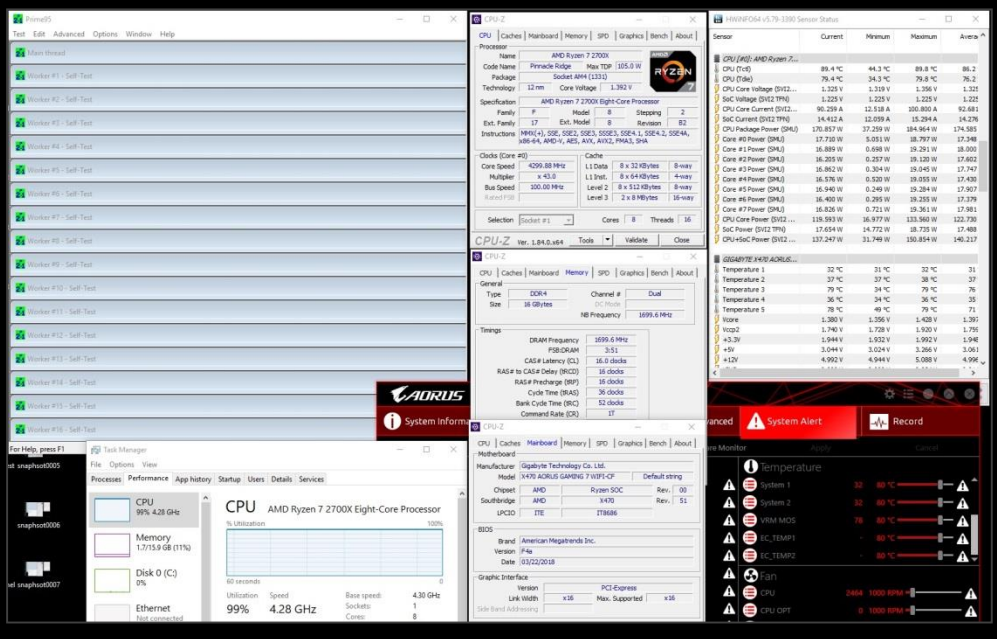
In order to reduce any possible Vdroop that interferes with our stability when overclocking, set LCC to “Turbo”. If the system is not stable, set the LLC to “Extreme”



■ Step 4: Stability Testing

Test the stability of these new settings by following the steps under “How to Stability Test” or use another lighter benchmark depending on what you are aiming for.
Below is an example of a Ryzen 2700X using a LEPA AquaChanger 240 AIO cooler.

It could pass prime95 for 30 minutes at 4.3 GHz.



And Cinebench R15 at 4350 MHz.