

BIOS and Tuning: Warning and Guide

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Introduction

This guide covers benefits and risks of tuning your system with our BIOS and 3rd party tools. This guide applies to all XMG and SCHENKER systems with the following CPUs:

- Intel Core i5-10210U and i7-10510U
- Intel Core i7-10750H and i7-10875H
- Various 10th Gen Intel Desktop CPUs

For the benefit of keeping your system safe, it is imperative that you **read this guide carefully**.

Worst Case Scenario: System does not boot and cannot be recovered

It is important to know that some tuning methods and settings will cause your system to run into a “no boot” scenario. Some of those scenarios cannot be recovered by the traditional methods of CMOS/BIOS Reset. Such methods include:

- Special hotkey combinations during boot to trigger a CMOS Reset
- Removing the CMOS Battery, Power Supply and Rechargeable Battery clear the CMOS

We call these methods “offline CMOS Reset”. These methods **do not work anymore** in recovering an unbootable system in most of the scenarios outlined in this guide.

In such a scenario, the only viable solution might be to fully overwrite the BIOS DMI chip on the mainboard using a specialized 8-pin BIOS SPI Flash Tool. This is something that cannot be done even by most expert users. Even the most computer repair shops will probably not have the necessary equipment and expertise to do such a recovery.

Only viable solution: RMA the system back to us – this scenario should be avoided at all cost.

Why does CMOS Reset not help?

CMOS Reset still exists and resets the typical common settings back to default. However, due to the underlying structure of the BIOS vendor (e.g. American Megatrends, Insyde), some advanced tuning settings including Voltage Offset and Memory Timing, Clock and Voltage are not able to revert by the offline CMOS Reset. We are not able to sufficiently explain the architectural reasons for this – but suffice it to say that this is based on the underlying architecture and not on any additions or changes we have done to our BIOS.

Can even software tools cause such a scenario?

Yes, even certain tuning software (including Intel XTU), using standardized Tuning/Overclocking APIs are able write values into the BIOS that are not able to revert if the system becomes unbootable. That is why it’s important that you know exactly how the software works and what risks are inherent in each setting before you attempt to modify any of the default settings.

Most Common Causes for 'No Boot' scenarios

The following pages will list and explain the most common causes of 'No Boot' scenarios and other tuning defects:

1. Undervolting and Overvolting beyond safe limits
2. Memory Tuning beyond safe limits
3. Deactivating or re-routing the output of Intel Graphics (iGPU)
4. Any other method under the general concept of 'Overclocking'
5. Tuning with 3rd party software

1. Undervolting beyond safe limits (high risk)

Undervolting is the deliberate reduction of electrical voltage on the CPU and GPU. On most systems, this is presented as 'Voltage Offset', which has these properties:

- If Voltage Offset is positive (+), voltage goes up, i.e. Overvolting
- If Voltage Offset is negative (-), voltage goes down, i.e. Undervolting
- Voltage Offset is usually specified in Millivolt, with the unit mV

Important lessons:

- Overvolting in laptop systems is not recommended at all because it increases temperatures
- Undervolting can slightly reduce temperatures, but if you reduce the voltage too much, your system will not boot anymore

Each CPU platform and generation might have different behavior and limitations. On *previous* generations (e.g. 9th Gen Intel Core), the safe limit for Undervolting has been around -100mV.

However, for Intel 10th Gen (Comet Lake), you might already start seeing stability issues, i.e. **Bluescreens at -50mV** and you will most definitely get an **Unbootable System at -80mV** and beyond.

Conclusion: do not attempt *any* Undervolting beyond -50mV on Intel Core 10th Gen (Comet Lake) systems. If you want to try Undervolting, it is imperative that you take **small steps, reboot**, and thoroughly test your system for stability before you attempt to go one step further. **Start with -10mV**, reboot and test. **Do not skip over any steps!**

2. Memory Tuning beyond safe limits (high risk)

Memory Tuning is a topic that is best left to the experts. The purpose is to run memory (RAM, DDR4) modules with certain advanced frequencies, timing and latencies that are not supported by your system vendor.

The memory controller is part of the CPU platform. Both Intel and AMD have certain standard for each CPU generation, which kind of memory they support.

For Intel Core 10th Gen (Comet Lake), Intel's platform support stops at DDR4 with 2933MHz and CL21 latency. The factory defaults of some of our systems go a little bit beyond Intel's standard: XMG PRO, ULTRA and SCHENKER KEY with Intel Core 10th Gen supports up to 3200MHz CL22 out-of-the-box.

However, if you want to run certain overclocking RAM SKUs with higher frequencies or lower latencies (for example 3600MHz CL16), you will find that your memory does not reach it's advertised specs. This is because the BIOS does not include the necessary profiles for such specs.

This is where some expert users might want to bring Manual Memory Settings into play. They might want to switch certain memory settings from “Automatic” to “Manual” and force the system to run them – no matter what. However, in this force lies the problem: if you force settings that CPU, chipset, mainboard or memory module just can’t support, you’ll find yourself with an unbootable system. Going back to your old stock memory modules might not help anymore, because your “forced” settings are still written into the BIOS.

The amount of settings that are theoretically available on DDR4 memory go beyond the scope of this document. They involve a lot of advanced mathematics and are difficult to understand – even for most advanced and expert PC users.

Conclusion: there is no simple “one-click” solution to operate memory specs that are not supported by your system vendor. We do not recommend memory upgrades with frequencies and latencies beyond those that we offer when we built your system. Forcing manual memory settings upon your system has a great risk of making your system unbootable without recovery. tl;dr: do not attempt Memory Tuning unless you know exactly what you are doing (and even then we do not give any guarantees).

3. Deactivating or re-routing the output of Intel Graphics (iGPU) (high risk)

First some glossary:

- iGPU = Internal GPU = Intel Graphics
- dGPU = Dedicated GPU = NVIDIA Graphics

Due to the design of MSHybrid and NVIDIA Optimus, the iGPU has the sole responsibility of providing an image to the screen of your laptop. If you disable the iGPU, you won’t get any image on your screen. Without your screen, you won’t be able to navigate the BIOS setup menu and run a CMOS Reset. The BIOS setup menu does not appear on external screens.

It is a common idea of some users to speculate whether they could improve their dGPU performance or compatibility by disabling the iGPU. Most common scenarios for this idea are applications that for some reason always seem to run on the iGPU. Another typical scenario are users who think their VR headset might work better if they disable the iGPU.

This line of thinking is false and dangerous. The iGPU is a core component of your system that **should not be disabled!**

If you seem to find tools or firmware options that claim to disable or uninstall the iGPU, **do not use them!** They might make your system become unbootable.

Exception: XMG NEO and XMG PRO series have a so called ‘MUX switch’. This is a hardware feature on the mainboard that allows you to switch the physical connection of the internal laptop screen between the iGPU and dGPU. This switch is controlled by a standard, non-hidden menu item in our official BIOS. This menu item has 2 selectable modes:

MSHybrid	MSHybrid is another word for NVIDIA Optimus. In this mode, the iGPU is connected to the internal screen.
Discrete	In this mode, the dGPU will take care of the internal screen

Conclusion: If you explicitly see a menu item with MSHybrid, then this item is supported and safe to use.

However, if you see menu items that claim to be able to disable or to route any GPU to any other display lane, do not use them.

4. Any other method under the general concept of ‘Overclocking’ (high risk)

With the exception of Undervolting (explained above), all Overclocking methods will sooner or later raise the power consumption of the system, which also increases the temperature output. In a system that is by design limited in how much heat it can dissipate, there is very little headroom for overclocking.

- Not all components on the mainboard have temperature sensors. Even if you can keep your CPU and GPU temperatures in check, you might still cause excessive heat in other areas.
- Components that exceed their thermal specifications might cause premature defects.
- Overclocking can damage your CPU, GPU, VRAM and other components on your mainboard over a short or long period of time – not only from temperatures but also from voltage and other electrical properties.
- Even before hardware defects occur, invalid or unsafe settings can cause a non-recoverable “No Boot” scenario as outlined above.

Conclusion: we do not support Overclocking on our laptops. Any attempt at Overclocking might void your warranty.

5. Tuning with 3rd party software (some risk)

Many of the actions outlined above can not only be triggered in the BIOS Setup Menu itself but also with software in Windows and Linux. This is due to common and standardized APIs that allow certain tools to modify certain settings in the BIOS Setup. Therefore, it is important to note, that system tuning with software **can be just as dangerous** as system tuning in BIOS setup. Here are a few examples:

Intel XTU (Extreme Tuning Utility)

Intel XTU is a powerful tool that is able to modify deeply rooted settings in the BIOS. Please note:

Settings are not applied in real-time. XTU requires an “Apply and Reboot” procedure because it is writing settings into the BIOS that are only applied on next boot-up.

So, if you want to test out settings in small steps (e.g. Undervolting), it is important that you apply and reboot each small before you test your new settings for stability.

Other 3rd party utilities

There are many tools that have gained popularity over the years. Among the most popular ones are ThrottleStop, ASUS GPU Tweak II, MSI Afterburner, NVIDIA Inspector.

None of these tools are validated or supported by your system vendor.

Modifying settings with these tools carries the same inherent risk like any other tool. If you set any settings to an invalid value or to a value that is outside of the operating range, **your system might not be able to boot anymore.**

This does not mean that we categorically deny the justification of using some of these tools in certain scenarios. For example, NVIDIA Inspector has a very nice (and harmless) FPS Limiter which can reduce your GPU Load in Gaming when V-Sync is off. But it is imperative that you know exactly what you are doing.

Rule of thumb: do not modify any settings where you are not 100% certain that you know that it is going to be safe.

Supported and safe tuning in our BIOS Setup

Now that we got all the warnings out of the way, let us discuss a few things that are supported and safe.

Our BIOS Setup for systems with Intel Core 10th Gen (Comet Lake) offers a reasonable set of options without going too far. Outside of the usual standards, we offer some additional settings that are aimed at security and customizations. These additional settings include:

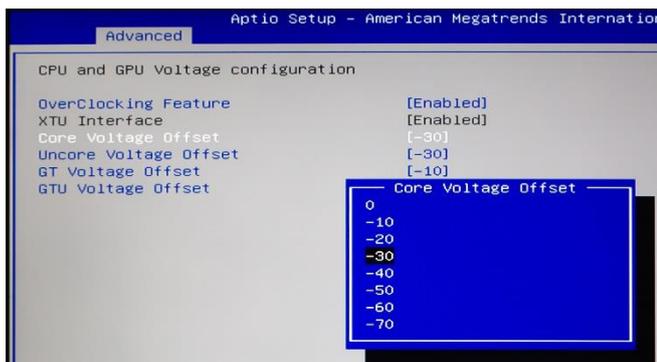
- Select Performance Profile
- Enable/Disable Keyboard Backlight
- Enable/Disable Webcam
- Enable/Disable Audio system incl. internal microphone
- Enable/Disable WiFi and Bluetooth
- Undervolting with reasonably safe limits

Undervolting in BIOS

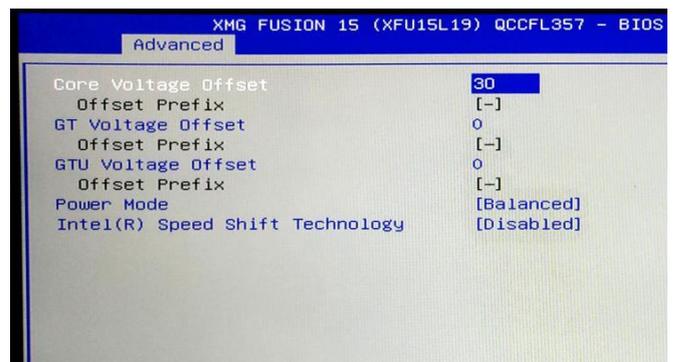
We have already discussed the risks of Undervolting beyond safe limits earlier in this document. Now we want to focus on the benefits and the correct method of applying it.

For a couple of years now, it has been one of our Enthusiast standards to allow CPU Undervolting directly in the BIOS setup of our XMG and SCHENKER models. Undervolting is a good way to squeeze more efficiency out of your system, reducing your system temperatures and fan speeds.

The BIOS Setup menu for most of our Intel-based systems offer very easy to use menu items to apply Undervolting. 'Core' and 'Uncore' refer to your CPU. Other options like GT, GTU, Graphics and Media refer to the iGPU.



Undervolting Menu on XMG CORE and XMG NEO



Undervolting Menu on XMG FUSION 15

Putting those options in the BIOS Setup avoids the usage of 3rd party apps and makes sure that your preferred values will always remain, even when you change performance profiles. Essentially, once you found the Undervolting sweet spot for your particular CPU, you can just keep it running in a kind of 'fire and forget' operation.

If you buy a High-end Desktop Gaming mainboard or if you play around with tools like Intel XTU or ThrottleStop, you will usually be able to set the Voltage Offset from to -500mV to +500mV which is not safe and stable at all. To make Undervolting more approachable even for users with little knowledge, we have set safe and reasonable limits on our Voltage Offset options. They only allow negative (minus) values, which only allows Undervolting, not Overvolting. Also, the offset is limited to a maximum value that we deem to be safe in avoiding the risk of 'No Boot' scenarios.

Safe CPU Undervolting Limits on Intel Core 10th Gen (Comet Lake)

On Intel Core 10th Gen (Comet Lake) we have limited the Undervolting to -50 or -70mV (depending on the system).

This does not automatically mean that each one of those maximum values are going to be 100% stable. You can divide stability into 5 levels:

CPU Stability Level	Description	Recommended action
<i>Fully Stable</i>	No Bluescreens, no problems. This is the only guaranteed level at 0mV (i.e. <u>no</u> Undervolting)	-
<i>Almost stable</i>	Rare, sporadic bluescreens after long-term usage in very specific conditions	Lower your Voltage Offset by one step.
<i>Bluescreen under load.</i>	Easy to reproduce Bluescreens during high CPU Load (e.g. Prime95).	High risk of tipping over into 'No Boot' scenario. Lower your Voltage Offset by one step.
<i>Bluescreen during Windows Boot</i>	System crashes already during the boot of the Operating System but you are still able to reach BIOS Setup (F2).	High risk of tipping over into 'No Boot' scenario. Reset to 0mV ASAP!
<i>'No Boot' scenario</i>	System crashes before reaching BIOS POST.	Not recoverable worst-case scenario. Requires RMA.

Which Stability Level you get on which Voltage Offset depends on your individual system. Generally, there is a range of stable values for each CPU generations, but the exact number depends on the individual unit. Every CPU will behave slightly differently, depending on CPU binning and memory configuration.

Testing the stability of each Undervolting step

For a quick test on the stability of your settings, we are going to stress the CPU and iGPU individually.

Tool	Description and Usage	Tips
Prime95	Multi-Core CPU Stress Test, calculating prime numbers. Has multiple profile with different loads on CPU and Memory. For maximum CPU Stress Test, we pick the "Small FFT" profile.	Even if you close the main window, the program might still be running in the background. Stop the stress test by right click on the Systray Icon and click 'Exit'
Furmark	GPU Stress Test, will be used later for iGPU Stress Testing. Renders a lot of hair which creates up to 99% load on the GPU. When launching Furmark, use right-click on the Desktop icon and select the 'Run with graphics processor', then select which GPU should do the rendering.	To really max-out the GPU, it is recommended to set the resolution to 1920*1080 and '8X MSAA'.

There are alternatives to these tools, but they all follow the same principle. The idea is to max-out CPU and GPU to see if your system can handle your new settings. You should keep it running for at least 5 minutes.

However, even if your system can pass the stress test, it might still cause stability issues later on in real work-scenarios under very specific conditions. This might be I/O usage, long up-time, certain temperature conditions etc.

Conclusion: if you think your setting is stable (passed the Stress Test) but you get a random Crash/Bluescreen after a couple of days or week, please go back to your Undervolting settings and turn them down by one step.

How to safely apply CPU Undervolting Step-by-Step

By default, your system's Voltage Offset will be at 0 (zero).

The BIOS Setup in most of our systems does not allow you to freely input a custom number. Instead, you can choose steps from a drop-down menu. Those steps usually come in intervals of 10mV.

Undervolting Steps:	
0.	0mV
1.	-10mV
2.	-20mV
3.	-30mV
4.	-40mV
5.	-50mV

If you want to tune your system with Undervolting, it is important that you do this in small steps. When you start at zero, your next step is to go to -10mV and then test the stability of your system in the **highest available performance profile**.

Here is what you should do **for each step** before you take it further:

- Run [Prime95](#) (Preset: Small FFT) or any other multi-core CPU stress test for at least 10 minutes
- Multiple reboots
- Use the system for a while for daily activity

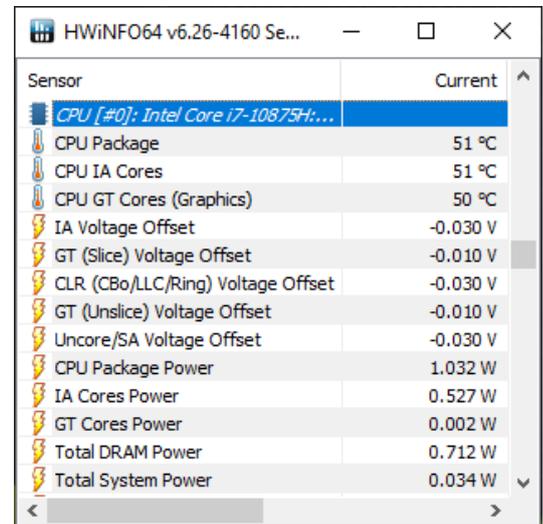
Only if you encounter zero issues (Bluescreens, Freezes) during your tests, you may take it **one step** further.

Do not skip any of these steps! If you encounter Bluescreens, Freezes or Boot issues, immediately go back and **take it down at least one step**.

Core, Uncore, GT, GTU – which value should I set?

Intel CPU and iGPU Voltage Offsets usually come in pairs. Different programs have different names for it, but they all describe the same 4 settings.

Common Name in BIOS	Name in Intel XTU	Name in HWiNFO64	Part of
Core	Core	IA Voltage Offset; followed by CLR (CBo/LLC/Ring)	CPU
Uncore	Cache	Uncore/SA Voltage Offset	CPU
GT	Graphics	GT (Slice)	iGPU
GTU	Media	GT (Unslice)	iGPU



Generally speaking, the pairs should always be set to the same values. For example: if you set Core to *minus 30mV*, you should also set Uncore to *minus 30mV*.

In our HWiNFO64 screenshot, you can see CPU at -30mV and iGPU at -10mV. This is how you can confirm that your offsets are really applied on the system.

Since Intel's Coffee Lake generation, 'Uncore' automatically follows the 'Core' setting. That's why some models will only expose 'Core' in the BIOS Setup. However, *if you see both* options available in BIOS Setup, they will still be set individually – meaning you should manually set them *both* in pairs. Finally, HWiNFO64 also shows CLR (CBo/LLC/Ring) – this is automatically set with 'Core', so you don't need to worry about it.

Conclusion: there are two pairs of settings. Within each pair, use the same settings for each individual item. However, do not set CPU and iGPU to the same levels without actually testing them individually. More information about iGPU Undervolting will follow in the next section of this document.

Undervolting on the iGPU

The same Step-by-Step approach applies to the iGPU (Intel Graphics) as well. Undervolting the iGPU implies the same risks regarding stability and the risk of ‘No Boot’ scenario. However, the symptoms of stability and the testing methods are different. Also, the safety levels might be different. Having your CPU (Core/Uncore) stable at a certain Voltage Offset level does not automatically guarantee that you can run your iGPU at the same level. It is still important to take it step-by-step from the beginning (zero).

Is iGPU Undervolting worth the effort?

Unless you run games or 3D applications on the iGPU and unless you use Intel QuickSync for encoding and live-streaming, the iGPU is not heavily used during most daily activities. For this reason, the benefit of iGPU Undervolting is very slim and does not warrant the time and risk.

Conclusion: we do not *recommend* iGPU Undervolting.

If you still want to try it anyway, please keep in mind that iGPU Undervolting has different testing methods and different worst-case scenarios. Please read the next paragraphs carefully.

Stability Levels

With iGPU Undervolting, there are *even more* potential layers of stability compared to the CPU.

iGPU Stability Level	Description	Recommended action
<i>Fully Stable</i>	No Bluescreens, no Freezes, no Graphics Artifacts. This is the only guaranteed level at 0mV (i.e. <u>no</u> Undervolting)	-
<i>Almost stable</i>	Rare, sporadic Bluescreens, Freezes or Graphics Artifacts after long-term usage in very specific conditions	Lower your Voltage Offset by one step.
<i>Graphics Artifacts under 3D load.</i>	Easy to reproduce graphics artifacts during high iGPU Load (e.g. Furmark or other 3D stress testing)	High risk of tipping over into ‘No Boot’ scenario. Lower your Voltage Offset by one step.
<i>Bluescreen, Black Screen or Artifacts in Windows.</i>	Easy to reproduce Bluescreen, Black Screen or Graphics Artifacts in Windows under load or normal operation.	High risk of tipping over into ‘No Boot’ scenario. Lower your Voltage Offset by one step.
<i>Bluescreen or Black Screen during Windows Boot</i>	System crashes already during the boot of the Operating System but you are still able to reach BIOS Setup (F2).	High risk of tipping over into ‘No Boot’ scenario. Reset to 0mV ASAP!
<i>‘No Boot’ scenario</i>	System crashes or only shows a Black Screen before reaching BIOS POST.	Not recoverable worst-case scenario. Requires RMA.

Here on the right is a screenshot of how these Graphic Artifacts in Furmark might look like.

Random squares, pixels, discolorations, irregular polygons etc. – anything that is out of the ordinary. It might look different in your case. As soon as you see **any artifacts**, abort the rest and **lower your Undervolting** at least one stop. **When in doubt, go back to 0 (zero).**



iGPU Undervolting Testing Methods

If you want to tune your iGPU with Undervolting, it is again important that you do this in small steps. When you start at zero, your next step is to go to -10mV and then test the stability of your system.

Here is what you should do **for each step** before you take it further:

- Run [Furmark](#) and [Prime95](#) simultaneously
 - Furmark: Right click -> Run with graphics processor -> Integrated Graphics
 - Prime95: Use 'Small FFT' preset for maximum CPU stress
- Multiple reboots
- Use the system for a while for daily activity

Only if you encounter zero issues (no Bluescreens, no Freezes, no Graphics Artifacts) during your tests, you may take it **one step** further.

Do not skip any of these steps! If you encounter Bluescreens, Freezes or Boot issues, immediately go back and **take it down at least one step**.

Final remarks & contact information

Thank you for reading this document. Let us repeat some core lessons:

- Undervolting is easy-to-do and has good benefits, but you **need to keep it within safe limits** and **take it step-by-step, from the bottom**
- Invalid options and out-of-range values can lead to a 'No Boot' scenario which you won't be able to recover without RMA
- Advanced tuning (including memory tuning) is better left to the experts and might not gain any significant benefits

If you need more support or if you have any questions about the information in this document, please do not hesitate to contact us.

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<i>Computerbase</i>	https://www.computerbase.de/forum/forums/schenker-notebooks.179/