



UNLEASH THE DRAGON

AMD "Dragon" Platform Technology Performance Tuning Guide



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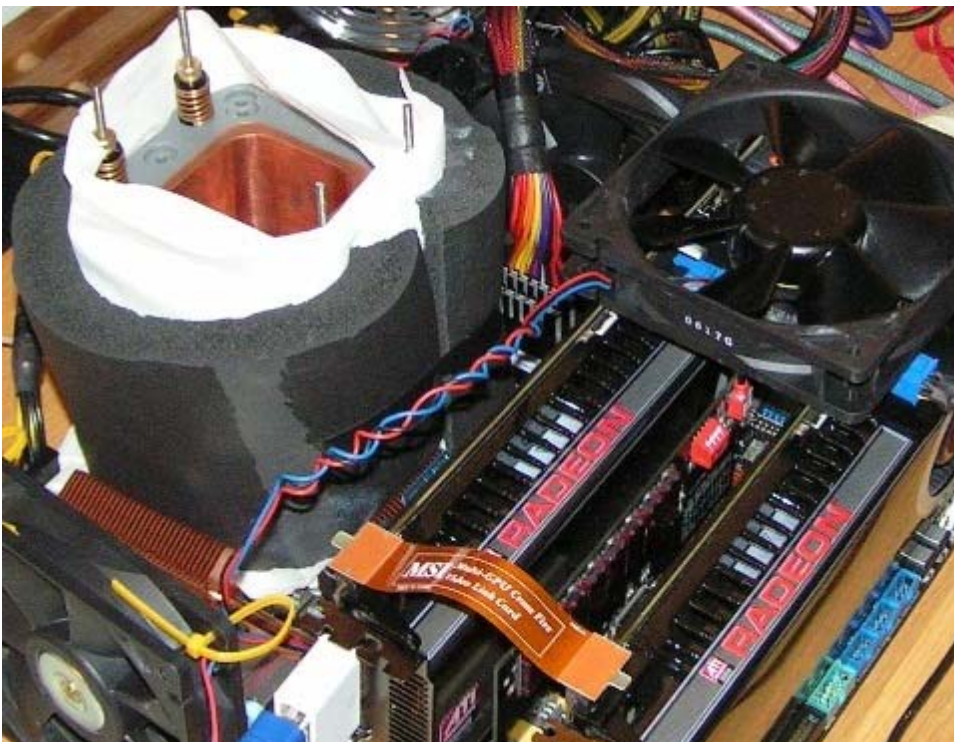
Introduction

Systems based on the platform technology codenamed “Dragon” may be tuned to deliver added system performance. The AMD Phenom™ II CPU and the AMD 7-series chipset motherboards offer an exciting amount of performance tuning options, including potential overclocking headroom. Note that each processor and chipset is different, and may result in lower or no overclocking margin.

The critically acclaimed AMD OverDrive™ utility gives users advanced control of system performance. This utility can be used to fine tune your performance settings in real time with easy-to-use screens designed for novice to expert users. More details on how to use the AMD OverDrive utility are included in the “AMD OverDrive utility” section of this guide.

The purpose of this document is to provide detailed information on the various performance tuning knobs that are present in systems based on the AMD “Dragon” platform technology. The guide will also offer various suggestions, “tips & tricks” and a comprehensive list of target clock speeds.

The combination of AMD “Dragon” platform technology, AMD OverDrive utility and optimal, fine tuned settings can be used to enable truly impressive performance tuning results!



AMD “Dragon” AM3 platform with aggressive cooling solution can enable record breaking benchmark results.

Glossary of Terms

HyperTransport™ Reference Clock (HT ref. clk): The base clock for various clock domains on the “Dragon” platform technology. HT ref. clock is 200MHz by default. CPU, CPU NB, HT Link and Memory clocks are all linked to HT ref. clock. HT ref. clock adjustment is a good tool for fine tuning the various clocks to optimal values. The HT ref. clock value itself doesn’t have any impact on performance.

CPU: Central Processing Unit – the engine of the “Dragon” platform technology. CPU core clock frequency has the biggest impact on overall performance of the system. It’s the primary target of tuning.

CPU NB: CPU NorthBridge (should not be confused with NorthBridge chipset, such as AMD 790FX) – part of the CPU that has its own clock domain and voltage plane. CPU NB clock frequency determines the Memory controller and L3 cache speed. CPU NB has a notable impact on overall system performance.

CPU FID: CPU Core Clock multiplier. In the case of the Phenom™ II X4 955BE CPU, the default CPU multiplier is x16 (16x200MHz = 3200MHz). CPU Multiplier can be adjusted on the fly with AMD OverDrive™ utility in steps of 0.5x. Note that the CPU Multiplier value can be individually adjusted for each of the CPU cores. FID is unlocked only on the Black Edition CPU models.

CPU NB FID: CPU NB Clock Multiplier. Determines the CPU NB frequency. In the case of the AMD Phenom II X4 955BE CPU, the default value is x10 (10x200MHz = 2000MHz). CPU NB Multiplier adjustment requires a reboot (it can not be adjusted on the fly). Can be adjusted in steps of x1. This will also determine the maximum HT Link multiplier value (i.e. HT Link Multiplier value can not exceed CPU NB Multiplier value). CPU NB and HT Link multipliers have the same value by default but the CPU NB FID may be increased beyond HT Link value. Note that FID is unlocked only on the Black Edition CPU models.

HT Link Multiplier: This multiplier determines the clock speed of the HT Link. In the case of the AMD Phenom II X4 955BE CPU, the default value is x10 (10x200MHz = 2000MHz). In most cases a reboot is required for HT Link Multiplier value adjustment. The maximum value of HT Link Multiplier is x13 and it can not exceed the CPU NB Multiplier value. Also note that the HT Link multiplier is unlocked only on the Black Edition CPUs models.

CPU VID: CPU Voltage Identification Digital – a register value that programs the motherboard voltage regulator (VR) to a specific value. In short, the CPU VID determines the CPU Core Voltage level. In the case of the AMD Phenom II X4 955BE CPU, the default CPU VID is usually 1.325V or 1.350V. The Maximum CPU VID value is 1.550V. **NOTE: VID value may not always equal to the actual voltage level** (see “Voltage OFFSET”). VID value can be adjusted on the fly with AMD OverDrive utility. Note: VID value can be increased only on the Black Edition CPUs.

CPU NB VID: CPU Voltage Identification Digital – a register value that programs the motherboard voltage regulator (VR) to a specific value. In short, the CPU NB VID determines the CPU NB Core Voltage level. In the case of the AMD Phenom II X4 955BE CPU the default CPU NB VID is usually 1.100V. The Maximum CPU NB VID value is 1.550V. **NOTE: VID value may not always equal to the actual voltage level** (see “Voltage OFFSET”). VID value can be adjusted on the fly with the AMD OverDrive™ utility. Note: VID value can be increased only on the Black Edition CPUs.

Glossary of Terms – continued

CPU / CPU NB Voltage OFFSET: Most “Dragon” platform technology motherboards have a BIOS option that allows Voltage adjustments beyond the CPU VID Voltage range. This voltage offset is added on top of the VID value. Voltage offset could be negative or positive. Actual voltage level = CPU or CPU NB VID + OFFSET.

Example: VID 1.350V + 0.100V OFFSET = 1.450V actual voltage level.

One of the following options will be available in the BIOS menu (depending on motherboard model):

- “CPU Voltage” and “CPU NB Voltage” item that includes both VID and OFFSET values merged into one voltage adjustment item (the range can go up to 1.900V)
- Separate items for CPU VID and CPU Voltage – here the “CPU Voltage” value starts from the VID value and then adds Offset on top of the VID
- CPU and CPU NB “OFFSET” items that control the amount of Voltage offset

In all cases the voltage level can be tuned on the fly with AMD OverDrive utility (VID sliders).

AMD OverDrive™ utility

The AMD OverDrive™ utility is a comprehensive utility for performance tuning, system monitoring and testing. **PLEASE NOTE THAT THE AMD PRODUCT WARRANTY DOES NOT COVER DAMAGES CAUSED BY RUNNING COMPONENTS OUTSIDE OF SPECIFICATION.**

Download from AMD Game! Website - http://game.amd.com/us-en/drivers_overdrive.aspx?p=1

Advanced Mode

The AMD OverDrive utility is a powerful tool with numerous features and options. However, in this section we have limited our discussion to only cover the Advanced User mode. The Advanced User mode of the AMD OverDrive utility allows full control over all the performance settings. This includes various clock frequency adjustments, clock multiplier settings, voltage tuning and memory timings.

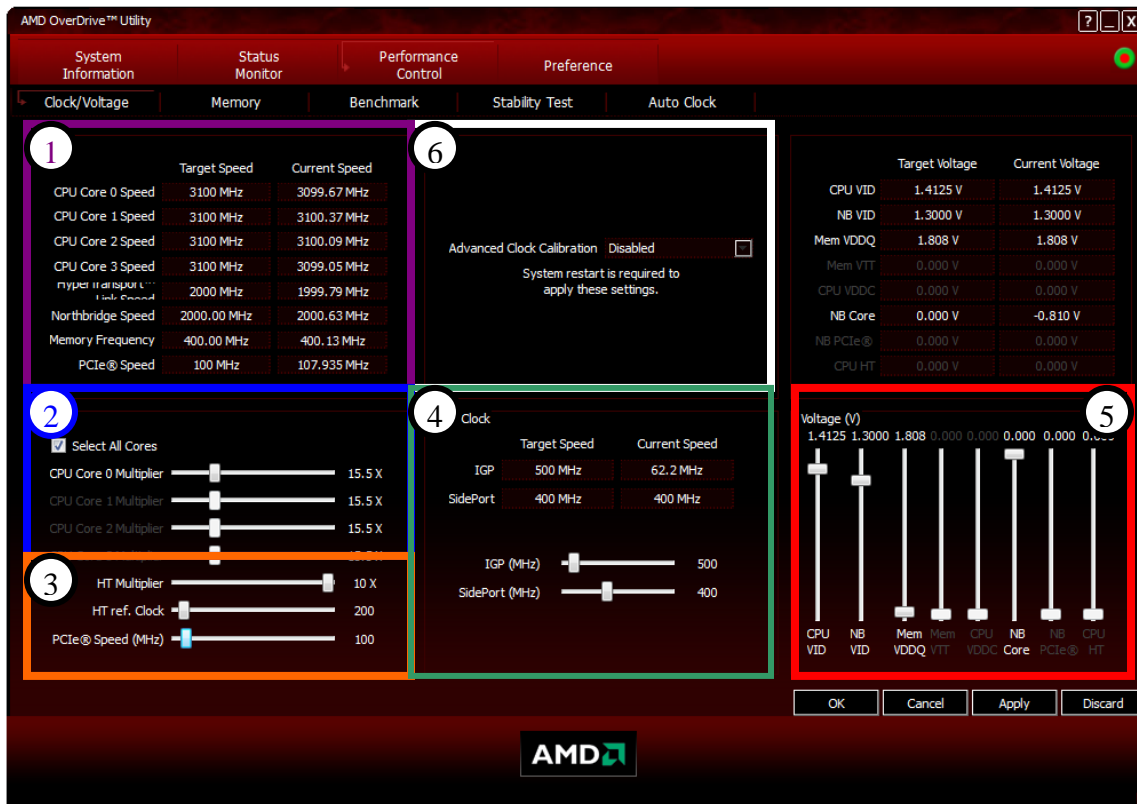


Figure 1: Screenshot from AMD OverDrive utility.

* AMD is not responsible for damages caused by overclocking (even when overclocking is enabled with AMD OverDrive™ Software). See disclaimer on page two (2) for more information.

Figure 1, presented above shows all the available clock/voltage tuning options available in the AMD OverDrive™ utility. The processor, northbridge, PCIe and memory can all be adjusted to obtain an optimally tuned system.

Detailed description of Figure 1 (AMD OverDrive utility screenshot):

Current clock speeds (1)

This section offers real-time monitoring for all the crucial clock speeds

Target clock speeds (1)

The values under this section are calculated based on the clock sliders. It is a convenient way to see the target clock speeds before actually applying the settings.

CPU Multiplier (2)

The sliders in this section control the CPU multiplier. In the case of AMD Phenom & AMD Phenom II CPUs each CPU core has its own multiplier slider (uncheck "All Cores" checkbox to enable control over individual CPU cores). In the case of the AMD Phenom Black Edition CPU the multiplier is unlocked and adjustable. Target clock speed (1) should be taken into account when adjusting CPU Multiplier to ensure that the CPU core clock speed doesn't reach unstable value.

HyperTransport™ (HT) reference clock (3)

Almost all the clocks are based on the HT reference clock (200MHz by default). Therefore adjusting the HT reference clock will increase the clock speed of most key components in the system. This includes CPU core clock, CPU NB clock (Memory controller), Memory clock and HT clock frequency. Again, please refer to the "Target Speed" section before actually applying the HT reference clock adjustment.

In many cases the HT reference clock margin can be limited by the System Memory clock. If this is the case, it is a good idea to adjust the System Memory settings to a lower value from the System BIOS [e.g. adjust Memclk mode from DDR2-800(400MHz) to DDR2-667(333MHz) and ensure that 2T timing and safe, manual memory timings are applied from the BIOS.]

HyperTransport™ (HT) Link multiplier (3)

This item can be used to adjust the HT Link multiplier value.

The range of HT Link multiplier depends on the CPU capabilities: with HT1 generation CPU the slider can only go up to X5 (1GHz mode), with HT3 generation of CPUs it can go up to X13 (2.6GHz mode). If HT3 CPU is booted up in HT1 mode (e.g. X5 or lower HT Link multiplier) it cannot be adjusted to HT3 mode on the fly. Switching from HT1 to HT3 mode requires a BIOS adjustment.

Memory Controller multiplier

CPU NB Clock multiplier is not adjustable on the fly. This item needs to be adjusted from the System BIOS.

PCIe® Speed (5)

This item controls the PCIe® clock frequency of the PCIe® graphics slots. By default this value is 100MHz. Increasing this value can provide slightly improved 3D performance.

CPU Core voltage adjustment (5)

This item can have two sliders: CPU VID and CPU VDDC. The amount of sliders depends on the motherboard that is being used. The CPU VID value is limited to max VID value (1.25V for instance) supported by the CPU. CPU VDDC (or CPU Vcore Offset) slider can be used to adjust the CPU Vcore above the max VID value.

Boosting the CPU Vcore voltage can improve the performance tuning headroom of the CPU Core.

PLEASE NOTE THAT CPU POWER AND THERMAL REQUIREMENTS INCREASE EXPONENTIALLY WHEN THE VOLTAGE IS INCREASED. VOLTAGE ADJUSTMENT IS ALWAYS A RISK AND CAN DAMAGE THE HARDWARE AND / OR SHORTEN THE LIFESPAN OF THE CPU OR OTHER COMPONENTS.

System Memory voltage adjustment (5)

This one can also have two sliders (depending on the motherboard that is being used). "Memory VDDQ" (memory core voltage) that defaults to 1.8V is the slider that should be adjusted in most cases. The other slider (Memory VTT) will adjust automatically according to the VDDQ slider adjustment. Normally the VTT level should be 50% of VDDQ level.

Boosting the memory voltage can improve System memory performance tuning.

PLEASE KEEP IN MIND THAT MEMORY VOLTAGE ADJUSTMENT IS THE MOST DANGEROUS VOLTAGE RAIL TO ADJUST AS IT CAN DESTROY NOT ONLY THE MEMORY BUT ALSO THE CPU AND CAN POTENTIALLY DAMAGE THE MOTHERBOARD.

ANYTHING BEYOND 2.0V VDDQ IS HAZARDOUS AND CAN DAMAGE THE CPU AND THE MEMORY MODULES.

Chipset voltage controls (5)

There are several voltage rails connected to the AMD 7-series chipset. The PCIe® bus, HyperTransport™ link and Chipset core all have separate voltage rails and controls. Boosting these voltage levels can result in improved performance tuning margin for these interfaces. For an example, boosting the HyperTransport™ link voltage by 0.1V can enable higher HT Link frequencies.

Advanced Clock Calibration (6)

ACC is a performance acceleration feature. This feature can enable greater performance tuning margin for the AMD Phenom™ Black Edition CPUs. The optimal gain can be seen in configurations that use high-end CPU cooling solution in combination with elevated CPU core voltage (CPU VID) value.

Memory Tuning

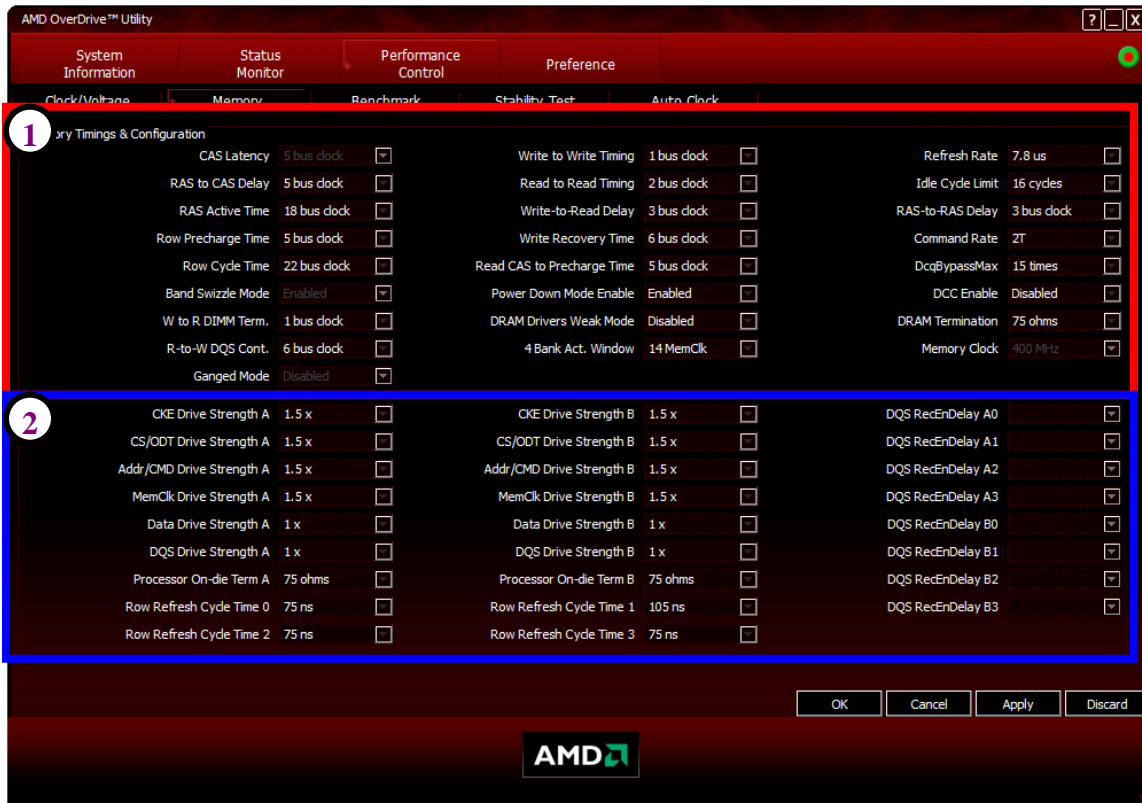


Figure2: AMD OverDrive™ utility Memory Tuning

Memory timing adjustments (1)

The items circled with red color can directly affect the overall system performance. Reducing these values can improve the performance / lower memory clock tuning margin whereas using higher values can enable higher memory clock speeds (but lower clock-to-clock performance).

PLEASE NOTE THAT SETTING ANY OF THESE VALUES TO AN INCORRECT / UNSTABLE VALUE CAN RESULT IN PROGRAM ERRORS OR SYSTEM CRASH / REBOOT. THE SAFE DEFAULT SETTINGS WILL BE APPLIED AFTER REBOOT.

Some of the items are read-only and can only be adjusted from the System BIOS.

Memory Drive strength control (2)

The lower half of the Memory tuning screen includes various Drive Strength control items.

Most of these items don't have an impact on performance; however, they can improve Memory clock tuning margin noticeably in some configurations.

AN INCORRECT SETTING CAN CAUSE THE SYSTEM TO CRASH / REBOOT.

AMD OverDrive™ utility Stability Test

The AMD OverDrive™ utility features an impressive system stability assessment. The “Stability Test” tab under “Performance Control” incorporates AMD’s CPU test algorithms to stress the CPUs worst-case scenario. The test consists of various parts that can be set to run only on a specific CPU core or on all CPU cores. It is also possible to select only specific tests to run. The amount of time the test will run can also be adjusted with the slider.

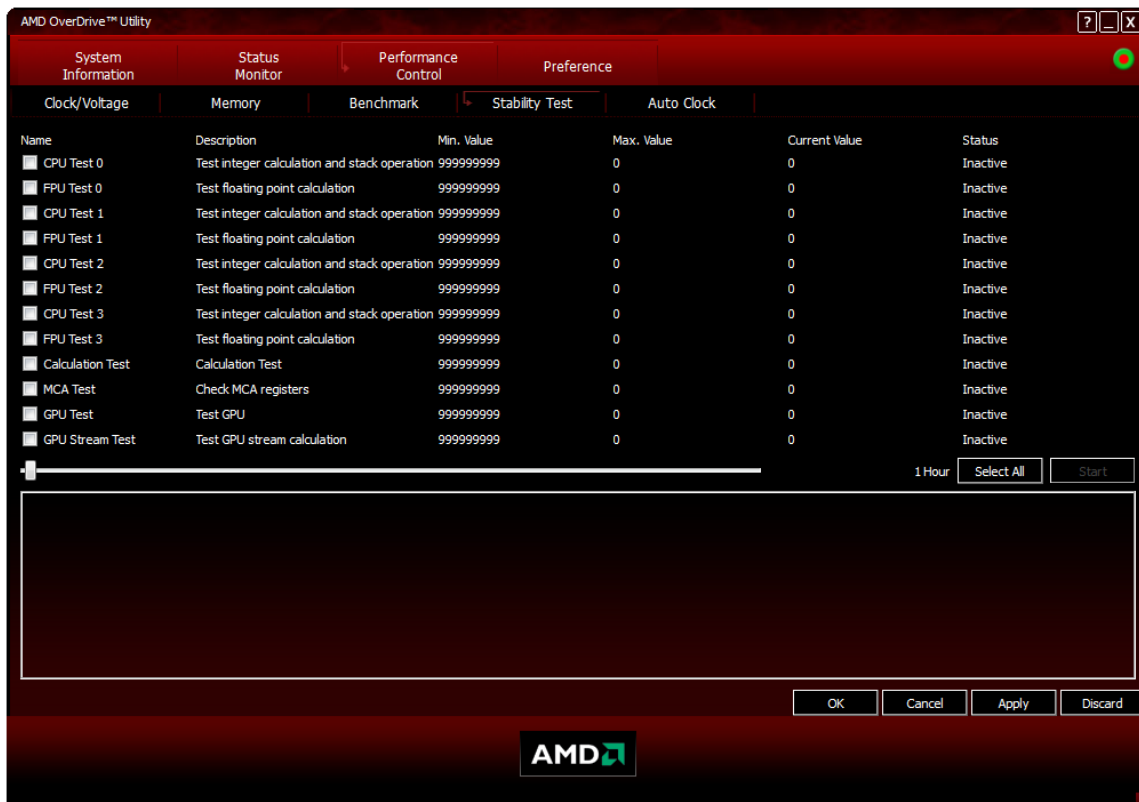


Figure 3: AMD OverDrive™ utility Stability Testing

Switching to other tabs in the AMD OverDrive™ utility does not impact the Stability Test. For instance, the settings under “Performance Control” can be adjusted while running the Stability Test.

AMD “Dragon” platform – Performance Tuning Suggestions

CPU Core Clock Performance Tuning

CPU core clock is the most important item to adjust for the advanced users when tuning the performance of the system. The CPU Clock speed has a big impact on overall system performance. The following steps explain how to determine CPU tuning margin.

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The key BIOS settings to adjust before proceeding with CPU Performance tuning:

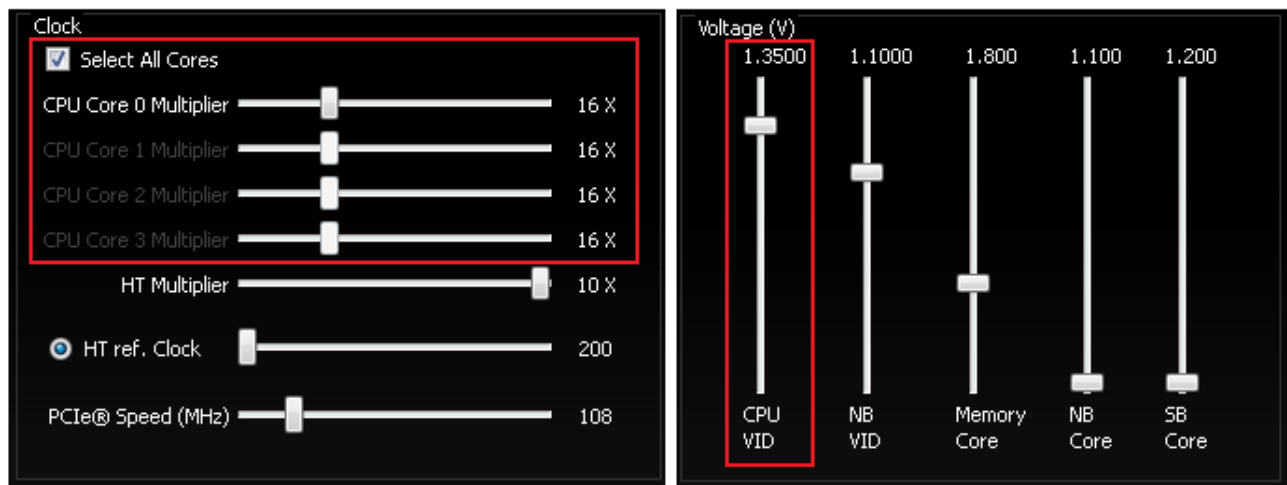
- Disable “Cool ‘n’ Quiet” –power saving item from the BIOS menu
- Disable “C1E” –item from the BIOS menu
- Disable “CPU Fan Control” –item from the BIOS menu (allows max cooling)
- Ensure that CPU NB, Memory or HT Link values are running at default stable values

The key settings in the Windows® XP or Windows Vista® operating system to adjust before overclocking the CPU:

- Close all major applications and background tools and save any open documents
- Set OS to “High performance” mode via “Control Panel / Power Options”
- Close any third party hardware / clock monitoring and system information programs

CPU tuning with the AMD OverDrive™ utility:

- 1) open AMD OverDrive (“AOD”)
- 2) browse to “Preference” tab and set the application from “Novice” mode to “Advanced” mode
- 3) enter the “Clock / Voltage” –tab under the “Performance Control” section
- 4) the two key sliders are “CPU Core Multiplier” and “CPU VID” – monitor the “Target speed” values before applying them. Make sure that “Select all cores” is checked



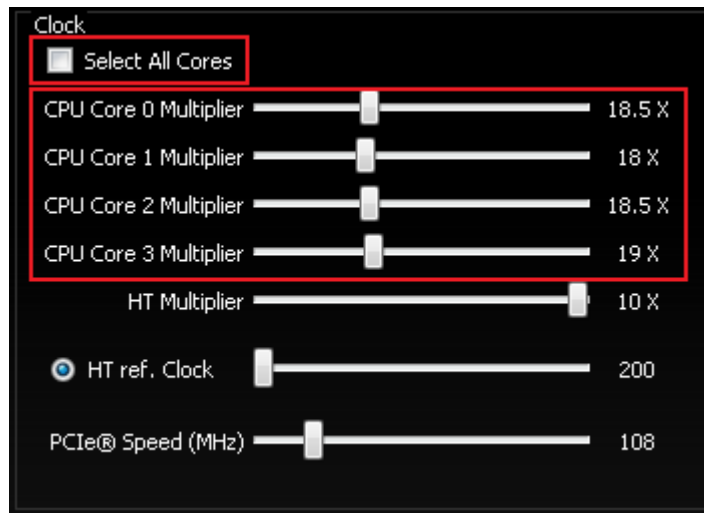
- 5) increase the values in small steps (example: set CPU Multiplier from x15 to x16 and CPU VID from 1.350V to 1.400V)
- 6) verify stability of the new settings with AOD Stability test or with 3rd party multithreaded benchmark (Cinebench 95 or 10 for example) or stress tester (OCCT) before increasing the CPU Multiplier or VID values to the next level. Note that the stress tester must be able to fully stress all CPU cores.

Please refer to “AMD “Dragon” Platform Technology Performance Tuning Targets” for the expected / optimal Multiplier and VID values.

Advanced CPU Core Tuning

There are a few additional items in the AMD OverDrive™ utility that can be used to improve the CPU tuning margin in some cases.

1) Individual Core Control



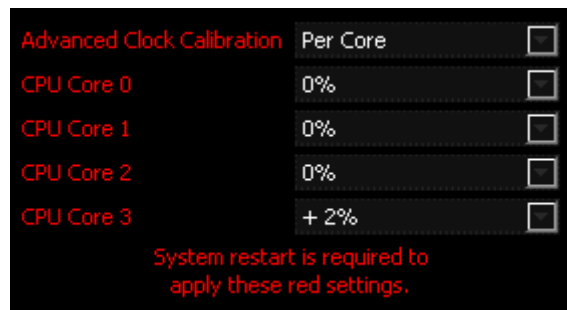
In this section the goal is to determine the performance potential of each CPU core individually. In contrast in the previous section we determined the maximum CPU Core clock that can be successfully applied to all CPU cores.

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Uncheck the “Select All Cores” item in the “AMD OVERDRIVE UTILITY Clock / Voltage” tab to enable the control over individual CPU core multiplier sliders. It is now possible to determine the performance potential of each individual CPU core by following the steps that were listed in the previous section. Find out the maximum stable value for each CPU core. Certain CPU cores performance may be improved more than others.

HT reference clock slider can be used for finer control over the CPU Core clock. 1MHz HT reference clock steps are available. This translates to 10-30MHz CPU Core clock steps depending on the CPU Multiplier used.

2) Advanced Clock Calibration



In case of the AMD Phenom II CPU, the “Advanced Clock Calibration” (ACC) feature can be used to improve the tuning margin of specific CPU cores. Typically the CPU core that has the lowest tuning margin by default is the likely candidate to see benefit from ACC-feature.

ACC can be enabled thru the AMD OverDrive™ utility or from the BIOS menu. Select the “Per Core” option and set the value of ACC to “+2%” for the CPU Core that has the least amount of headroom. Set the rest of the CPU cores to “0%” (default value).

Note that the system needs to be restarted before the new settings will be applied. Restarting the system is required each time the value(s) of ACC are adjusted.

CPU NorthBridge Performance Tuning

The CPU NorthBridge (CPU NB) clock speed determines the efficiency and bandwidth capacity of the Memory controller. L3 cache runs at this frequency as well. CPU NB performance tuning gives a measurable boost for overall system performance. In particular it can reduce the Memory latency and improve L3 cache bandwidth and latency. In some scenarios the CPU NB should be tuned in order to take the full advantage of overclocked Memory frequency and bandwidth. In general the CPU NB clock should be at least three times the Memory clock (example in case of DDR3-1600: 3 x 800MHz = 2400MHz NB clock).

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In terms of power delivery and voltage regulation the latest AM2+ and AM3 motherboards have a dedicated power plane for the CPU NB Voltage rail. The voltage level of CPU NB power plane (CPU NB VID) can be set independently from the CPU Core Voltage rail (CPU VID).

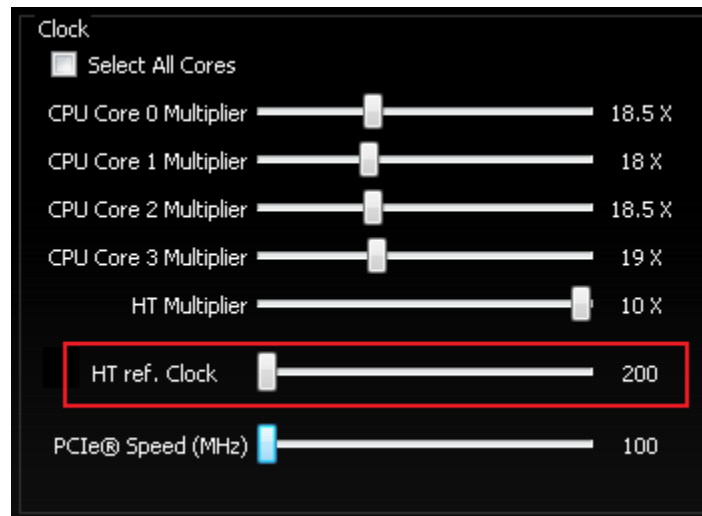
The frequency of CPU NB is determined by the CPU NB Multiplier (CPU NB FID) and by the HT reference clock (HT ref. clock, 200MHz by default). CPU NB Multiplier can not be changed on the fly (as various memory parameters and memory training is based on the NB clock value). A reboot is required in order to adjust the CPU NB Multiplier. Therefore the performance tuning of CPU NB is mostly done thru the BIOS menu. Note that CPU NB Multipliers are integer values and therefore the adjustment will be in steps of 200MHz or more (depending on HT ref clock value). The combination of “HT ref clock” and the “CPU NB Multiplier” adjustment in the BIOS menu will allow finer steps.

HT reference clock adjustments can be done on the fly via the AMD OverDrive™ utility and this allows finer granularity for CPU NB Performance tuning and may reduce the time required for tuning (as there is no need to reboot the system between different HT ref. clock values).

CPU NB performance tuning with AMD OverDrive™ utility (HT ref. clock):

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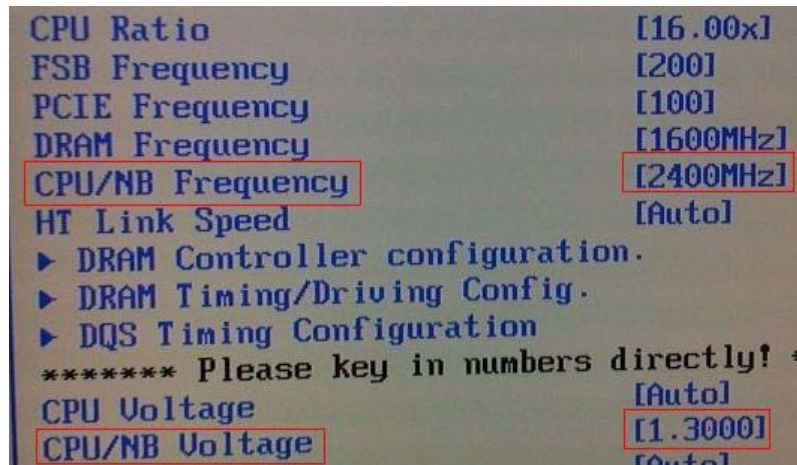
- Set CPU NB and HT Link multiplier to known good values (example: default, 1800MHz or x9)
- Set CPU Core Multiplier(s) / Voltage to a known stable setting before proceeding with CPU NB performance tuning (to ensure that CPU core doesn't cause stability issues / crashes)
- Set Memory clock and timings to known stable settings (example: DDR3-1333 CL9-9-9 for AM3 or DDR2-800 CL5-5-5-15-2T for AM2+), note that Memory interface will also be overclocked when HT ref. clock is adjusted. Memory must be able to run 10% above default clock during the CPU NB tests. Set Memory to DDR3-1333 or DDR3-1067 mode (DDR2-800 or DDR2-667MHz mode for DDR2 / AM2+) and boost Memory voltage to 1.600V (1.90V for DDR2 / AM2+) to ensure stability
- Adjust "HT ref. clock" slider in AOD (2MHz steps for accuracy, 5MHz steps for less accurate but faster results)



- Run a stability test before increasing the HT ref. clock to another level
- Adjust CPU NB VID voltage slider in AOD if there were any stability issues (in 0.050V steps – if a boost of 100mV doesn't provide any improvement for stability then the limit has been found)
- Once the CPU NB clock has been increased by 200MHz (the next step available via CPU NB Multiplier change) while maintaining good stability, reboot and enter the BIOS menu in order to increase the NB Multiplier (see the next section)

CPU NB performance tuning through the BIOS menu:

- Set the CPU NB clock speed up to the next available value (example: if 1800MHz / x9 is the default and NB clock testing via AMD OverDrive utility was OK at 2000MHz then set CPU NB BIOS item to 2000MHz / x10 now)
- Set CPU NB Voltage to a known stable value (based on the NB clock testing done thru AMD OverDrive utility)
- Keep HT Link multiplier at default value (example: 1800MHz or x9 in case of the AMD Phenom II X4 940BE CPU)
- Set CPU Core Multiplier(s) / Voltage to a known stable setting before proceeding with CPU NB performance tuning (to ensure that CPU core doesn't cause stability issues / crashes)
- Set Memory clock and timings to known stable settings (example: DDR3-1333 CL9-9-9 for AM3 or DDR2-800 CL5-5-5-15-2T for AM2+), note that Memory interface will also be overclocked when HT ref. clock is adjusted. Memory must be able to run 10% above default clock during the CPU NB tests. Set Memory to DDR3-1333 or DDR3-1067 mode (DDR2-800 or DDR2-667MHz mode for DDR2 / AM2+) and boost Memory voltage to 1.600V (1.90V for DDR2 / AM2+) to ensure stability
- Reboot the system with the new CPU NB Multiplier / Voltage value and continue HT ref. clock testing thru AMD OverDrive™ utility (as instructed in the previous section)



The alternative approach is to adjust everything directly from the BIOS menu and utilize a bootable stand-alone stability tester such as Memtest86 or Memtest86+ (may be installed on a bootable USB key).

Please refer to “AMD “Dragon” Platform Technology Performance Tuning Targets” for the expected / optimal Multiplier and VID values.

NOTE: CPU NB Multiplier value can not be increased above the default value unless an unlocked AMD Phenom II Black Edition CPU is used.

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Memory Performance tuning – AM3 / DDR3

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Memory clock speed is tied to HT ref. clock with certain ratios. The following **Memory clock modes** are available on the AMD “Dragon” AM3 DDR3 platform technology:

- DDR3-800 (400MHz) – 2:1 ratio
- DDR3-1066 (533MHz) – 8:3 ratio
- DDR3-1333 (667MHz) – 10:3 ratio
- DDR2-1600 (800MHz) – 4:1 ratio

In the case of AM3 DDR3 platform, there are two key strategies for Memory tuning:

- 1) utilize DDR3-1600 Memclk mode (800MHz) with CL7-7-7...CL9-9-9 timings (depending on the DIMM specification and headroom) and minor HT ref. clock boost (below 225MHz)
- 2) utilize DDR3-1333 Memclk mode (667MHz) with faster CL5-5-5...CL7-7-7 timings and HT ref. clock boost (the amount of HT ref. clock boost will depend on the DIMM OC headroom)

Option #1 is easier and works in most cases, offering the optimal amount of memory bandwidth and latency. Option #2 could enable the absolute highest Memory performance depending on memory modules but may require more manual tuning. Option #2 could be optimal when using DRAM modules capable of CL6-6-6 timings at DDR3-1600 speeds.

The optimal memory voltage will depend on the DIMMs. In general there are two DDR3 DIMM categories: high voltage DIMMs that run best at 1.85...2.05V and low voltage DIMMs that prefer 1.6...1.7V.

The optimal Tras and Trc timing parameter value is calculated as follows:

$$\text{Tras} = \text{Tcl} + \text{Trcd} + \text{Trp}$$

Example: Tras should be set to 21 in case of CL7-7-7 -settings

$$\text{Trc} = \text{Tras} + \text{Tcl}$$

Example: Trc should be set to 28 in case of CL7 + Tras = 21 -settings

Enabling 2T –timing mode can improve stability with 4GB or 8GB memory configurations (but will cause a slight performance hit).

The Memory controller of AMD Phenom and AMD Phenom II CPUs can be set to run in **Ganged mode** or in **Unganged mode**. Ganged mode means that there is a single 128bit wide dual-channel DRAM Controller (DCT) enabled. Unganged mode enables two 64bit wide DRAM Controllers (DCT0 and DCT1).

The recommended setting in most cases is the Unganged memory mode. Ganged mode may allow slightly higher Memory performance tuning and performs well in single-threaded benchmarks.

Depending on the motherboard and BIOS, it may be required manually setting the timing parameters for each DCT (in Unganged mode) when performance tuning the memory or fine tuning the timings. Some BIOS versions apply the same timings automatically for both DCTs in an Unganged mode.

The DIMM slots furthest away from the CPU socket should be equipped first (usually marked as DIMM slot 2&3 or A2&B2).

Memory Performance tuning – AM2+ / DDR2

Memory clock speed is tied to HT ref. clock with certain ratios. The following **Memory clock modes** are available on the AMD “Dragon” AM2+ DDR2 platform technology:

- DDR2-400 (200MHz) – 1:1 ratio
- DDR2-533 (266MHz) – 4:3 ratio
- DDR2-667 (333MHz) – 5:3 ratio
- DDR2-800 (400MHz) – 2:1 ratio
- DDR2-1066 (533MHz) – 8:3 ratio

When HT ref. clock value is increased beyond the default 200MHz then the Memory clock value will also increase depending on the Memory clock mode and the ratio selected.

Example: 210MHz HT ref. clock and DDR2-667 memclk mode will result in 350MHz (DDR2-700) memory clock speed ($210 \times 5 / 3 = 350\text{MHz}$)

In case of Dragon AM2+ DDR3 platform, there are two key strategies for Memory tuning:

- 3) utilize DDR2-1066 Memclk mode (533MHz) with CL4/5-5-5-15-2T timings and minor HT ref. clock boost (below 225MHz)
- 4) utilize DDR2-800 or 667 Memclk mode (400 or 333MHz) with faster CL4-4-4-12 timings and noticeable HT ref. clock boost (above 250MHz)

Option #1 is easier and works in most cases offering the optimal amount of memory bandwidth and latency. Option #2 could enable the absolute highest Memory performance depending on memory modules but requires more manual tuning and usually higher voltage levels. Option #2 could be optimal when using DRAM modules capable of CL4-4-4 timings at DDR2-1200 speeds.

It's important to turn on the “2T mode” from the BIOS when testing with DDR2-800 and DDR2-667 modes with higher HT ref. clock value.

HyperTransport™ (HT) reference clock

HT reference clock value has no direct impact on system performance. Therefore the maximum amount of HT reference clock tuning is not required in order to get the highest performance. HT ref. clock can be used to fine tune and dial in the other key clock values on the AMD “Dragon” platform technology. In some cases a relatively high (over 250MHz) HT reference clock might be required for optimal performance. The role of HT reference clock margin becomes critical in particular with multiplier locked CPUs.

In general it's a good idea to test how high the HT reference clock can be pushed. This is a useful data point to have when performance tuning the system (even an unlocked CPU).

PLEASE NOTE THAT THE AMD PRODUCT WARRANTY DOES NOT COVER DAMAGES CAUSED BY RUNNING COMPONENTS OUTSIDE OF SPECIFICATION INCLUDING DAMAGES CAUSED BY OVERCLOCKING (EVEN WHEN OVERCLOCKING IS ENABLED WITH THE AMD OVERDRIVE UTILITY).

- 1) Configure CPU, CPU NB, Memory mode, Memory timings (2T mode) and HT Link multiplier to values that allow good margin for HT reference clock overclocking
 - o The mentioned clock domains must be able to run at least 20% higher than the specified multiplier / memclk mode
 - o This is to ensure that HT ref. clock margin testing is not limited by the other components
- 2) Load OS and start AMD OverDrive utility
- 3) Start the AMD OverDrive utility stability tester
- 4) Adjust HT reference clock slider in 2MHz steps until the system hangs
- 5) Enter the BIOS menu and set HT ref. clock to a value that is a bit lower than the value that previously failed (example: if 260MHz failed in AMD OVERDRIVE utility, then set BIOS to 255MHz)
 - o Check that CPU, CPUNB, HT Link and Memory are still at safe values after the HT ref. clock change. Reduce multiplier values as needed
- 6) Return to step #2 and repeat until the maximum HT reference clock value is found

Please refer to “AMD “Dragon” Platform Technology Performance Tuning Targets” for the expected HT ref. clock tuning margin.

HyperTransport™ (HT) Link frequency

HyperTransport Link frequency will determine the available bandwidth between the CPU and the NorthBridge Chipset (such as AMD 790FX). In most single CPU socket configurations the default 1.8GHz or 2GHz HT Link value offers sufficient amount of bandwidth even for multi-GPU configurations. Increasing HT Link frequency may provide a small performance boost for certain 3D applications, games and benchmarks.

Similar to CPU and CPU NB clock, the HT Link frequency is tied to HT reference clock (increase in HT ref. clock will increase the HT Link frequency). Multiplier values from x1 thru x13 are available in case of an unlocked AMD Phenom II Black Edition CPU. It is possible to tune the HT Link frequency by adjusting the HT Link multiplier to a higher value and / or by increasing the HT reference clock.

Note that HT Link multiplier value can not exceed the CPU NB Multiplier value and that CPU HT Link multiplier is locked in case of a locked, non-Black Edition AMD Phenom II CPU.

“Dragon” Platform Technology – Performance Tuning Targets

The following table lists some possible results for an unlocked AMD Phenom II Black Edition CPU as well as the optimal voltage values for most “Dragon” platform technology systems.

Note that these results are strictly estimates based on overclocking data from a limited sample size. The actual results will vary depending on the CPU, motherboard, cooling solution and memory modules used in the tests.

The “air cooling” column and the suggested Voltage and Frequency values are based on the assumption that a high-end heatsink and fan is used.

The “extreme” column lists the suggested Voltage settings and expected target Frequency values for Liquid Nitrogen (LN2) cooling solution (-196C).

Item	Voltage		Frequency	
	air cooling	extreme	air cooling	extreme
CPU Core clock	1.35 - 1.50V	1.65 - 1.85V	3800 - 4100MHz	5600 - 6300MHz
CPU NB clock	1.35 - 1.50V	1.40 - 1.55V	2800 - 3000MHz	3900 - 4600MHz
HT Link clock	1.20 - 1.35V	1.20 - 1.40V	1000 - 2700MHz ⁽¹⁾	1000 - 3000MHz ⁽¹⁾
DDR3 Memory clock	1.80 - 2.00V	1.90 - 2.10V	1700 - 1850MHz	1700 - 1900MHz
DDR2 Memory clock	2.0 - 2.3V	2.0 - 2.3V	1150 - 1200MHz	1175 - 1225MHz
HT reference clock	NA	NA	280 - 330MHz	300 - 400MHz

1. HT Link speed of 1.6-2.0GHz offers optimal amount of bandwidth and stability for nearly all single socket configurations. Setting HT Link mode to x5 (1GHz) can improve stability under LN2 cooling.



ATTRIBUTION

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