Beginners Guide to Overclocking

Posted by Vairo - 2007/07/17 19:08

Warning

Before we start, a word of warning, overclocking voids your warranty and increases the risk of premature death of you're hardware. The use of extreme voltages can lead to instant death of hardware if you are careless. Overclocking can also kill your Windows install so back-up anything important!

The Basics

Overclocking is the process of making your hardware run faster than it was orginally sold at. It's possible because of the way Intel and AMD run their manufacturering processes. All processors of a common core design are created equally and a process of speed binning is used to decide what speed it's sold at. This is essentially testing a sample (or perhaps all) from a batch to determine how quick they can run at. But if the process produces more chips that can run at a higher speed than they can sell they will often sell these CPUs at a lower speed. It's these chips that are the best for overclocking.

Current low end A64s/X2s and Core 2 Duos are all excellent for getting substantial overclocks.

The Essentials - Hardware

CPU - Read around the forums and see what the "buzz" is.

Motherboard - Often overlooked, but absolutely essential. The MB itself must be a good overclocker. There's no point getting a good clocking CPU if the motherboard itself isn't

RAM - Though not essential due to memory dividers, RAM can be overclocked as well. In many cases vendors sell the same RAM chips in their mid range (and even cheaper) RAM as they do for their high end RAM. Only difference is the price.Current kings of air cooling are, amongst others, the Scythe Ninja, Thermaltake Big Typhoon, and Arctic Cooling Freezer 7/64 Pro. The cooler a processor the faster it can run and the more volts you can put through it.

Thermal Interace Material - TIM is the compound between the CPU and HS. It displaces any air between the two surfaces improving heat transfer (air is an insulator). AS5 and Liquid Metal are the best performing TIMs, but the TIM supplied these days with most heatsinks will perform to within a degree of two of these two so it's not something to worry about if you don't have any.

The Essentials - Software

BIOS - The BIOS contains the basic settings of your system and is where all the overclocking options are contained. Manufacturers often release improved BIOSes that offer better overclockability and stability. Refer to the MB manual for information about updating you're BIOS.

Monitoring Software - It's handy to know what voltages and temperatures you're tinkering are producing.

http://www.almico.com/sfdownload.php shows CPU, MB and HD temperatures and also voltages!

http://www.thecoolest.zerobrains.com/forum...topic.php?t=137 Shows your cores temperatures!

Stability Testing Software:

http://www.mersenne.org/freesoft.htm most used tests when CPU clocking!

http://sp2004.fre3.com/download.htm Prime95 with improved GUI!

http://sp2004.fre3.com/download.htm SP2004 with added dual core functionality in one instance!

http://www.futuremark.com/download/ test everything CPU/RAM stability !

http://www.cpuid.com/cpuz.php CPU ,RAM information!

Basic Concepts

Before starting overclocking make sure you know how to clear the CMOS (the memory that holds the BIOS settings) in case of settings that don't let you get back into the BIOS. Details on how to do this are in the motherboard manual but it typically involves moving a jumper on the motherboard or removing a battery (or both).

Front Side Bus (FSB)

The FSB is the key frequency that we are interested in. The CPU clock speed and RAM speed are derived from it as well as the A64s Hypertransport frequency (though HT provides most of the functions previously associated with the FSB, the CPU clockspeed is still manipulated by the FSB option in the BIOS).

CPU Multiplier

The CPU multiplier determines the overall speed of the CPU by multiplying the FSB. For example a multiplier of 10 and a FSB of 200MHz results in a clockspeed of 2000MHz (2GHZ). Most CPUs have restricted multipliers, A64s are locked upwards, Intels are generally fully locked. AMD FX and Intel Extreme Edition Core 2 Duo chips are fully unlocked (within reason). Can also be refered to as FID on A64s.

Vcore

Vcore is the voltage supplied to the CPU. Increasing this voltage in moderation allows you to overclock the CPU more at the expense of higher loads temps. What's a safe Vcore? Personally a 15% overvolt on air if temperatures are acceptable.

RAM Divider

When I refer to RAM clockspeed I always refer to the actual clock rate, not the double data rate. For PC3200 RAM this is

200MHz, not the 400MHz quoted for the DDR. Dividers describe the relationship between the FSB and the RAM clock speed. BIOSes typically do this in two methods, the first is to give you the RAM speed in relationship to the FSB at stock (so for example 166MHz would represent a ratio of 5:3 - FSB:RAM). Others will just give you the actual ratio so that you can work it out for yourself. More recent boards now give you the actual RAM speed and this chances as you chance the FSB. Might also be called DRAM Frequency.

VDIMM
VDIMM is the RAM voltage. Always set the RAM voltage manually, as many MBs will default to 2.6V for DDR and 1.8V for DDR2, when in fact to run at their rated speed most high performance chips will require significantly more (2.8-2.9 typically for DDR and 2.2 for DDR2). Visit the manufacturer's website to find out the specific voltage for your RAM. Note that RAM can be overclocked by increasing the voltage above this value as well.

Chipset Voltage
The chipset helps interface the CPU with other components on the MB and each type of chipset has specific features like whether it supports SLI or Crossfire or RAID. The chipset may have multiple voltage settings associated with it such a Vnb, Vsb, Vmch, Vchipset, Vfsb. Each having an effect on memory stability or maximum stable FSB.

Hypertransport Frequency/Multiplier - A64s
This is specific for A64s and X2 processors, the hypertransport is 1000MHz, derived from 5xFSB. Many boards can't handle significant overclocks of this bus, so it's best to reduce the multiplier to 4 or 3 depending on how high the FSB is. The performance difference between 800 and 1000MHz is insignificant so don't be concerned if you're particular combination results in a relatively low value. Hypertransport settings may also be referred to as LDT frequency etc.

PCI/AGP/PCI-E Clockrate
These need to be locked, in the bad old days these were often derived from the FSB mean as you increased the FSB so did the PCI bus. This would often prove do be limit of overclocking not the CPU. Where the option exists it's best to set these to PCI - 33MHz, AGP - 66MHz, PCI-E - 100MHz. Leaving them on Auto may lead to unpredictable results.

Temperatures
Temperatures are the enemy of overclockers. Reducing temperatures has a direct effect on your ability to overclock a CPU, so by using increasingly aggresive cooling methods will nearly always allow you to overclock further for a given voltage. What's a maximium safe temperature? Use Core Temp to give you indication of the maximum temperature that a CPU is designed for. Recent P4s and Core 2 Duos will throttle if they get hot. Throttling is where they either reduce the clockspeed by reducing the CPU multiplier or by inserting idle instructions into the CPU to reduce the temperature. Typical figures are otherwise about 60C for A64s and a bit more for P4s/Core 2 Duos, though throttling should protect them.
Overclocking
The process of overclocking is an iterative process, where you gradually make changes and test to see how stable it is. You should only be making one change at a time so that you can assess if the change improves things, if it doesn't change it back and change something else. Also keep a note of your last stable settings so that you can revert to them if you reach a point where several minor increases in voltage etc makes no difference to stability.

If you're not comfortable with any of the voltages you're applying or temperatures you're reaching then stop and get a second opinion as there is plenty of people on the forum who are willing to give advice.

First off, in the BIOS set as many settings as possible to manual rather than auto. And switch on/off any features particular to your board that hinder overclocking (things like Cool and Quiet for example).

Finding Max FSB
First off, for CPUs that allow you to change (lower) the CPU multiplier, it is handy to determine what the maximum stable FSB of you're MB is. If you don't have the option to lower multipliers skip this section.

1. Increase the FSB by 5MHz.
2. Reduce the multiplier and RAM divider if requried so that both are at stock speeds or slightly less.
3. Boot into windows and run SP2004 Blend Test, this will also stress the chipset and RAM so will be testing the FSB not just the CPU.
4. Run it for 30mins monitoring temperatures, if it doesn't fail goto 1 again, if it fails, go to step 5.
5. Increase the chipset voltage a notch and go back to 4.

Eventually increasing the voltage will have little effect on increasing the FSB. At this point run a full range of tests and increase the duration of your SP2004 testing to 8 hours (some recomend more, some less, for me 8 hours is how long I'm at work give or take). If it fails any tests, reduce the FSB by 5MHz and retest until the required level of stability is achieved.

Finding Max CPU Clockspeed

1. Increase the FSB by 5MHz.
2. Decrease the RAM divider if required to keep it at stock or less
3. Run SP2004 Small FFT to test stability
4. Run it for 30mins, it may be worth testing for FSB stability as well if you haven't already proven FSB stability at this point. If it passes return to 1, if it fails goto 5. Keep an eye on temperatures whilst testing.
5. Increase the Vcore a notch and repeat the testing phase until temperatures are getting close to the maximum for your CPU, or the voltage increases don't allow you to overclock any further.

Once you've reached a point where you've maxed out voltage/temperature or you've reached a point where you're not comfortable with the voltage you're using run SP2004 for longer and also a full range of test to check for stability. If you find that it's not quite stable after the longer testing knock 5MHz off the FSB and retest until stable.
Dual Core Overclocking
Dual/multi core overclocking is essentially the same as single core overclocking, the only real difference is the method of establishing stability. S&M and SP2004 Orthos both work "out of the box" with dual cores. Otherwise multiple instances of other programs might need to be run, which can also involve multiple installation folders.

Memory Overclocking
Process is roughly similar to that of CPU overclocking. With A64s it's easy to test RAM overclockability by reducing the CPU multiplier so that when you increase the FSB the CPU is still below it's stock speed and only the RAM is running faster than stock. On Intels once you've established a stable CPU overclock you can increase the RAM divider to start overclocking the RAM and then manipulate the FSB so that the CPU remains below the stable maximum. You may find that with both overclocked you're CPU overclock might be slightly reduced. On top of overclocking RAM you can also tighten timings, more information can be found in the Memory stickies.
More on Stability Testing
Prime95/SP2004/Orthos
I'm going to treat these as one and the same thing as they're all based on the same stress test software.

To maximise the stress on the system when running the tests change the priority to 10 (in SP2004/Orthos) or for Prime, in the Task Manager, change it's priority to Real Time. This ensures that it gets priority over other programs that are also running and maximises the stress on the CPU.

Small FFT
Hits the CPU the hardest, doesn't use RAM much if at all so is a very good indication of CPU stability.

Large, In Place FFT
Increases FFT length, making use of more RAM. Bit of a half way house between Small and Blend so probably not that great a test as it has neithers strengths though it will likely make greater use of the CPU cache so it might reveal any issues there.

Blend
Primarily uses the RAM instead of cache so stresses the memory controller and RAM as well as the CPU. In my experience this fails quicker due to RAM than Memtest86 does. This is probably best to test the memory subsystem after you've stress tested the CPU by itself.

StressCPU (Orthos only)
Not sure about this one, Small FFT seems to stress the CPU more.

How Long to Run?
Very much a personal preference this one, my opinion is that for the overclocking process 30mins is enough, as it'll typically fail in the first 10mins if it's not very stable. Only once you reach a point that you can't get anyfurther should you be looking to run extended testing for x hours. 2 hours might be enough for some, 24 hours for others, but it seems reasonable to do it during the hotest time of the day.

S&M
I found this was the best stress test for A64s for CPUs, but with my Conroe it's no where near as good Prime Small FFT at stress testing. On A64s I found it would be several degrees hotter than Prime, but on Conroe, Prime is a good 5C hotter and fails quicker.

CPU (FPU) is the one to use for CPU stress testing. 15mins should be good enough, or 2hours is the full length test.

It also has a built in RAM tester that seems to be pretty good as well.

SuperPi(Mod)
More of a benchmarking tool than a stability test, but the 32MB test can give a good indication of overall stability and

tests both RAM and the CPU. For dual cores you must install the program twice into separate folders and run .

Select Calculate in the menu bar and then whatever test you want to run in the drop down menu.

3dMark
Graphics benchmarks that also stress the CPU and RAM so can be used as good overall system stability tests. 3dMark is also sensitive to things like driver issues and of course GPU overclocks so it's a good idea to run these before you start chaning things to make sure that any issues are ironed out first.
What is a Stable System?

Is System that doesn't crash/error when using whatever programs the user uses. Many will argue that it's only stable if it doesn't crash no matter what you throw at it, but if you're not ever going to be fully stressing the system why bother spending days ensuring it?

cheers to Jokester from O.C.cu.uk thanks to them i managed to OC even my own machine :evil:

Post edited by: Vairo, at: 2007/07/17 16:19

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Re:Beginners Guide to Overclocking
Posted by BVG - 2007/08/11 23:02

Wow nice artikel

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Re:Beginners Guide to Overclocking
Posted by Vairo - 2007/08/11 23:42

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thanks it helped me a lot when i was overclocking my own conroe .

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Re:Beginners Guide to Overclocking
Posted by Scott6969 - 2007/08/12 02:50

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very nice Vairo, yeah i reccomend if you are going to OVERCLOCK make sure your semi experienced... just incase you do f*ck it up & then your left without a pc & data may be lost.

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Re:Beginners Guide to Overclocking
Posted by Carlito - 2007/08/12 17:29

Well i might try it one day , will see how my PC will cope when i upgrate , nice quide Vairo.

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Re:Beginners Guide to Overclocking
Posted by tsalo - 2007/08/14 17:07

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just yesterday i bought zalman 9700 LED for my E6600 i'm hoping to OC to 3.6 with it :) maybe i'll post some pictures when i'm going to mount this big thingie.

actually i was between 2 ??high-end?? air coolers, zalman 9700 and the other one was thermaltake big typhoon 120. the last one had better results in cooling but it was too big for my configuration - measured it precisely before buying anything :P

and soon winter is coming and winters are very cold in estonia :D extra OC power for crysis muaha :woohoo:

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Re:Beginners Guide to Overclocking

Posted by Haze - 2007/11/15 01:37

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really nice vairo. great article.

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